CEOCOR

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INSULATING JOINTS FOR GAS PIEPELINES

Quality, testing and arrangement of insulating joints in gas pipelines

RECOMMENDATION

CONTENTS

Preface

This technical recommendation for the manufacture, testing and the installation of electrical insulating joints in gas pipelines made of metal (pipeline and plant) has been prepared by CEOCOR section A in cooperation with competent experts.

1 Scope

This recommendation applies for quality, manufacture, testing and installation of factory-produced insulating joints in pipelines and plant as well as those that are integrated in barriers and suitable for gases of the categories 2 and 3 according to EN 437.

This recommendation does not deal with questions of guarantee and oher commercial aspects.

2 Functions and applications of insulating joints

2.1 An insulating joint is a non-conductive pipe connection that interrupts the linear electrical conductivity of a metal pipeline.

2.2 The insulating joint is used for :

- demarcation of cathodic protection areas
- interruption of pipe current flows (e.g. stray currents, geomagnetic currents)
- local limitation of inductive influences - shock protection
- prevention of the gas pipeline becoming an earth line
- separation of metal pipelines made of different material or covered with different sheaths.

2.3 The installation of insulating joints may be required in the following cases :

- in metal pipelines for the electrical separation of line sections
- in gas pressure regulators and measuring systems as well as in compressor plants where the metal lines enter and leave
- in valve and scraper stations, if these have to be separated electrically from the pipeline
- in control and measuring lines, if these adversely effect the cathodically protected part of the installation
- buried house connection lines and supply pipes made of metal.

2.4 Insulating parts are preferred to insulating flange joints, because the former can't be removed later and therefore prevent more reliably their mechanic and electrical qualities.

3 Terminology

3.1 Electrical insulating joint

3.1.1 Insulating joint

The insulating joint is a factory-produced, ready-to-fit pipeline element, that can't be taken apart and that serves for the interruption of the electric linear conductivity of a pipeline.

3.1.2 Ready-to-fit insulating flange joint

A ready-to-fit insulating flange joint is a factory-produced, ready-to-fit flange joint that functions as an insulating joint due to is special construction.

3.1.3 Insulating flange pair

An insulating flange pair is a factory-produced insulating flange joint that must be taken apart when it is welded into the gas pipeline.

3.1.4 Barrier fitting with integrated insulating joint

A barrier fitting with integrated insulating joint is a structural component of a pipeline that unites the function of the barrier fitting and the insulating joint.

3.2 Creep distance

A creep distance is the shortest distance on the surface of insulating parts between the conducting parts.

3.3 Air gap

An air gap is the shortest distance in the air between conducting parts.

3.4 Test-alternating voltage

A test-alternating voltage is the effective value of an alternating voltage applied during the test period at a certain frequency.

3.5 Gap section

A gap section is the smallest thickness of the insulating material between the parts that have to be separated electrically.

3.6 Overvoltage protection device

An overvoltage protection device is an installation for the protection of the electric equipment and systems against inadmissible high overvoltage.

3.6.1 Spark gap

A sparkgap is the distance between electrically conducting parts that is bridged by arcs in case of electric flash over.

3.6.2 Spark bridge

A spark bridge is an overvoltage protection device integrated in the insulating joint.

4 General

4.1 The factory must produce the insulating joints so that they are ready to fit and that they conform to the technical requirements for construction, quality and pneumatic test for the proposed installation.

4.2 The material used(seals, plastic, laminated fabric rings, etc) must be resistant to gases of the category 2 and 3 according to EN 437.

4.3 Insulating joints must be designed so that they do not lose their effectiveness if imperviousness is tested or moisture penetrates.

4.4 In order to avoid the danger of inadmissible temperature rise of the insulating joints during welding, the open pipe ends of ready-to-fit insulating joints must not be below the following minimum:
100 mm when applying SMAW (electronic welding)
250 mm when applying OAW (autogenic welding)

4.5 In order to ensure that the insulating joints can be welded into the pipelines, the steel quality of the open pipe ends must correspond to the regulations according to EN 10208-2.

4.6 When welding the insulating joints by electric welding, the earth contact must be fixed exactly. If the earth contact is fixed on the wrong position (welding current might flow over the insulating joint), the insulating joint can be destroyed.

5 Insulating joints for operating pressures of more than 16 bar

5.1 General

5.1.1 For every type of construction or for a modification of the original construction plan, a prototype testing by an authorised testing agency (accredited testing laboratory) must be proved.

5.1.2 The components of insulating joints must be tested. The test results must be proved in writing and presented to the customer.

5.1.3 Insulating joints destined for installation into gas pipelines made of steel must be designed to resist the nominal pressure of the line and must correspond to EN 10208-2.

5.1.4 When producing the insulating joints a quality status corresponding to EN 729-1 and EN 729-3 must be observed while welding.

5.1.5 When the test pressure of the line does not exceed the test pressure of the insulating joint the latter can also be installed into the line before the pressure of this line is tested.

5.2 Construction requirements

5.2.1 The calculation of the parts under pressure must be based on a load factor of at least S = 1,8.

5.2.2 The customer has to specify the desired steel quality of the welding ends. The maximum CEV (carbon equivalent) must correspond to the regulations according EN 10208-2.

5.2.3 The welding ends of insulating joints have to be designed corresponding to EN 10208-1, table 10.

5.2.4 The insulating joints must be designed for a minimum temperature range of the medium of -10°C up to +50°C. Differing temperatures have to be specified by the customer.

5.2.5 In order to exclude damage to the inner seal parts of the insulating joints owing to lightning or high tension interactions, appropriate construction measures must ensure that a possible electrical flash over can not occur inside the pipeline. An electrical flash over must not affect the imperviousness of the insulating joint.

5.2.6 In order to protect an insulating joint against flash overs owing to lightning and high tension interactions, an overvoltage protection device with a maximum operating impulse voltage according to the half of the test voltage (withstand alternating voltage) of the insulating joint and with a leakage impulse current of 50 kA (waveform 10/350 µs corresponding to IEC 1024-1 and IEC 1312-1) must be provided.

5.2.7 The overvoltage protection device should be fixed directly on the insulating joint (maximum loop length 300 mm). In special cases the overvoltage protection device can be fixed above ground at an accessible measuring point if the lengthened line feed is designed with the lowest impedance possible corresponding to the determined length of the loop. To be efficient the overvoltage protection device must be connected with the insulating joint with a maximum connection inductance of 0,3 µH. This can be obtained by using a maximum loop length of 300 mm or other line feeds with low impedance, e.g. co-axial cables, drilled lines, etc. whose total inductance does not exceed 0,3 µH and is resistant to high lightning current (at least 16 mm^2 Cu according to IEC 1024-1)

5.2.8 If the insulating joint is placed in an explosive gas atmosphere a surge arrester with the respective licensing corresponding to EN 50014 must be used. In this case it is important to consider that the connection on the insulating joint also has to be explosion proof.

5.2.9 When using insulating joints with an integrated spark bridge the corresponding proofs according to 5.2.5, 5.2.6 and 5.2.8 must be presented - except the demand that the operating voltage must not exceed half of the test voltage.

5.2.10 Only insulating joints that are welded or constructed in an other appropriate way can be used. Pressed types similar to those in fig. 3 are not permissible in this pressure range.

5.2.11 Appropriate material (e.g. composite coating material on the basis of phenonol-resin strengthened with paper or reinforced paper) serves as insulating material.

5.2.12 In piggable lines the inside diameter of the insulating ring must have the same size or must be up to at most 3 mm smaller than the inside diameter of the insulating joint.

5.2.13 In non-piggable lines the inside diameter of the insulating ring can be up to 10% smaller than the inside diameter of the insulating joint.

5.2.14 O-ring-seals with regular roundings are recommended as sealing material. The sealing rings must be placed on appropriate drop-shaped grooves or grooves in another shape that are found in the metallic material.

5.2.15 Underground insulating joints must suitably be coated or wrapped. Above ground insulating joints may be coated with a non-conductive material (beware of shock protection!).

5.2.16 The external coating and primer must be compatible.

5.2.17 Factory-coated insulating joints with welding ends must have an open, uncoated pipe end of at least 150 mm.

5.2.18 The exterior coating of insulating joints with flange connection must, corresponding to fig. 1, reach up to the flange; the sealing surface of the flange as well as the bearing surface of the screw joints must be free of any coating.

5.2.19 The insulating joints must also be coated inside, in order to prevent an electrical bridge caused by a foreign element inside the insulating joint. This interior coating can for instance be achieved by applying a PE- or EP-coating (preceding sandblasting is absolutely necessary) or a two-component high-build coating.
The coating thickness must be at least 0,4 mm and abrasion-resistant.

5.2.20 The inner side must be coated as far as the sealing chamber or continuously by passing the insulating ring (fig. 1) and as far as a distance of 150 mm from both welding ends.

5.2.21 In insulating joints with flange connection the interior coating must reach on both sides up to the inner edge of the flange.

5.2.22 Each insulating joint must be marked on a visible place with the following information:

- make
- type designation
- serial number or acceptance number
- nominal width (DN)
- nominal pressure (PN)
- steel quality of the pipe ends
- mark of the testing agency or of the tester.

5.3 Test conditions and tests

5.3.1 Strength analysis

In the factory each insulating joint must pass a water pressure test carried out under a pressure of at least 1,5 times the nominal pressure for at least 5 minutes. In this test the ends are to be closed so that the axes of the insulating joint are not under pressure.

The procedure of the strength analysis can be agreed between the customer and the manufacturer.

5.3.2 Leakage test

After the water pressure test, a leakage test must be carried out with air under a pressure of 5 bar for a period of at least 10 minutes before self-polishing. In this test leakage is not permissible.

5.3.3 Electrical test

Each insulating joint must be tested in dry conditions with a minimum voltage of 5000 V~(50Hz) for 1 minute. During this test there must not occur a corona discharge or an insulation failure.

The maximum leakage current (at 5000 Volt, 50 Hz) depends on the capacity of the relevant insulating joint (type, size, nominal width, pressure stage, etc.). For the recommended values for the maximum leakage current see table 1.

Table 1: Recommended values for the maximum leakage current (composed of ohmic and capacitive current)

	≤ PN 16	≤ PN 70	≤ PN 100
3 mA	≤ DN 800	≤ DN 400	≤ DN 200
10 mA	> DN 800 ≤ DN 1200	> DN 400 ≤ DN 800	> DN 200 ≤ DN 600

After the water pressure test the insulation resistance of the dry insulating joint must be at least 0,1 MΩ when measuring with a direct voltage of at least 500 V. After a drying period of 5 hours at room temperature a value of at least 100 MΩ must be achieved.

5.3.4 Exterior coatings made in the factory must pass a non-porosity test with an alternating voltage of 25 000 V.

5.3.5 The results of the non-porosity test of the exterior coating can also be integrated in the test certificate of the insulating joint.

5.3.6 The conformity with the desired qualities and the data corresponding to 5.2.22 have to be attested according to EN 10204 with an acceptance test certificate 3.1.A or 3.1.C.

5.3.7 When using steel qualities with a yield point of > 360 N/mm², for the open pipe ends an acceptance test certificate 3.1.A or 3.1.C according to EN 10204 is also required for the pipe material (see prEN 1594).

6 Insulating joints for operating pressures of over 4 bar up to 16 bar

6.1 General

6.1.1 For every type of construction or for a modification of the original construction plan, a prototype testing by an authorised testing agency (accredited testing laboratory) must be proved.

6.1.2 The components of the insulating joint must be tested. The test results must be proved in writing and presented to the customer.

6.1.3 Insulating joints destined for installation into gas pipelines made of steel must be designed to resist the nominal pressure of the line and must correspond to EN 10208-1.

6.1.4 When producing the insulating joints a quality status corrresponding to EN 729-1 and EN 729-2 must be observed while welding.

6.1.5 When the test pressure of the line does not exceed the test pressure of the insulating joint the latter can also be installed into the line before the pressure of this line is tested.

6.2 Construction requirements

6.2.1 The calculation of the parts under pressure must be based on a load factor of at least S = 1,8.

6.2.2 The customer has to specify the desired steel quality of the welding ends. The maximum CEV (carbon equivalent) must correspond to the regulations according to EN 10208-2.

6.2.3 Generally, the welding ends of insulating joints have to be designed corresponding to EN 10208-2, table 10.

6.2.4 The insulating joints must be designed for a minimum temperature range of the medium of -10°C up to +50°C. Differing temperatures have to be specified by the customer.

6.2.5 In order to exclude damage to the inner seal parts of the insulating joints owing to lightning or high tension interactions, appropriate construction measures must ensure that a possible electrical flash over can not occur inside the pipeline. An electrical flash over must not affect the imperviousness of the insulating joint.

6.2.6 In order to protect an insulating joint against flash overs owing to lightning and high tension interactions an overvoltage protection device with a maximum operating impulse voltage according to half of the test voltage (withstand alternating voltage) of the insulating joint and with a leakage impulse current of 50 kA (waveform 10/350 µs corresponding to IEC 1024-1 and IEC 1312-1) must be provided.

6.2.7 The overvoltage protection device should be fixed directly on the insulating joint (maximum loop length 300 mm). In special cases the overvoltage protection device can be fixed above ground at an accessible measuring point if the lengthened line feed is designed with the lowest impedance possible corresponding to the determined length of the loop. To be efficient the overvoltage protection device must be connected with the insulating joint with a maximum connection inductance of 0,3 µH. This can be obtained by using a maximum loop length of 300 mm or other line feeds with low impedance, e.g. co-axial cables, drilled lines, etc. whose total inductance does not exceed 0,3 µH and is resistant to high lightning current (at least 16 mm^2 Cu according to IEC 1024-1)

6.2.8 If the insulating joint is placed in an explosive gas atmosphere a surge arrester with the respective licensing corresponding to EN 50014 must be used. In this case it is important to consider that the connection on the insulating joint also has to be explosion proof.

6.2.9 When using insulating joints with an integrated spark bridge the corresponding proofs according to 6.2.5, 6.2.6 and 6.2.8 must be presented - except the demand that the operating voltage must not exceed the half of the test voltage.

6.2.10 Only insulating joints that are welded or constructed in an other appropriate way can be used. Pressed types similar to those in fig. 3 are not permissible in this pressure range.

6.2.11 Appropriate material (e.g. composite coating material on the basis of phenonol-resin strengthened with paper or reinforced paper) with a minimum coating thickness of 8 mm serves as insulating material.

6.2.12 In piggable lines the inside diameter of the insulating ring must have the same size or must be up to at most 3 mm smaller than the inside diameter of the insulating joint.

6.2.13 In non-piggable lines the inside diameter of the insulating ring can be up to 10% smaller than the inside diameter of the insulating joint.

6.2.14 O-ring seals with regular roundings are recommended as sealing material. The sealing rings must be placed on appropriate drop-shaped grooves or grooves in another shape that are found in the metallic material.

6.2.15 Underground insulating joints must besuitably coated or wrapped. Above ground insulating joints may be coated with a non-conductive material (beware of shock protection!).

6.2.16 The external coating and primer must be compatible.

6.2.17 Factory coated insulating joints with welding ends must have an open, uncoated pipe end of at least 150 mm.

6.2.18 The exterior coating of insulating joints with flange connection must, corresponding to fig. 1, reach up to the flange; the sealing surface of the flange as well as the bearing surface of the screw joints must be free of any coating.

6.2.19 The insulating joints must also be coated inside, in order to prevent an electrical bridge caused by a foreign element inside the insulating joint. This interior coating can for instance be achieved by applying a PE- or EP-coating (preceding sandblasting is absolutely necessary) or a two-component high-build coating.
The coating thickness must be at least 0,4 mm and abrasion-resistant.

6.2.20 The inner side must be coated as far as the sealing chamber or continuously by passing the insulating ring (fig. 1) and as far as a distance of 150 mm from both welding ends.

6.2.21 In insulating joints with flange connections the interior coating must reach on both sides up to the inner edge of the flange.

6.2.22 Each insulating joint must be marked on a visible place with the following information:

- make
- type designation
- serial number or acceptance number
- nominal width (DN)
- nominal pressure (PN)
- steel quality of the pipe ends
- mark of the testing agency or of the tester.

6.3 Test conditions and tests

6.3.1 Strength analysis

In the factory each insulating joint must pass a water pressure test carried out under a pressure of at least 1,5 times the nominal pressure for at least 1 minute. In this test the ends must be closed so that the axes of the insulating joint are not under pressure.

The procedure of the strength analysis can be agreed between the customer and the manufacturer.

6.3.2 Leakage test

After the water pressure test, a leakage test must be carried out with air under a pressure of at least 5 bar for a period of at least 10 minutes before self-polishing. In this test leakage is not permissible.

6.3.3 Electrical test

Each insulating joint must be tested in dry conditions with a minimum voltage of 5000 V~(50Hz) for 1 minute. During the test there must not occur a corona discharge or an insulation failure.

The maximum leakage current (at 5000 Volt, 50 Hz) depends on the capacity of the relevant insulating joint (type, size, nominal width, pressure stage, etc.). For the recommended values for the maximum leakage current see table 1.

After the water pressure test the insulation resistance of the dry insulating joint must be at least 0,1 MΩ when measuring with a direct voltage of at least 500 V. After a drying period of 5 hours at room temperature a value of at least 100 MΩ must be achieved.

6.3.4 Exterior coatings made in the factory must pass resist a non-porosity test with an alternating voltage of 25 000 V.

6.3.5 The results of the non-porosity test of the exterior coating can also be integrated in the test certificate of the insulating joint.

6.3.6 The conformity with the desired qualities and the data corresponding to 6.2.22 have to be attested according to EN 10204 with an acceptance test certificate 3.1.B.

6.3.7 When using steel qualities with a yield point of > 360 N/mm², for the open pipe ends an acceptance test certificate 3.1.A or 3.1.C according to EN 10204 is also required for the pipe material (see prEN 1594).

7 Insulating joints for operating pressures of up to 4 bar7

7.1 Insulating joints for underground installation

For underground installations only insulating joints for operating pressures of over 4 bar may be used according to sector 5 or 6.

7.2 Insulating joints for exclusively above ground installation

7.2.1 General

These insulating joints must be licensed by an accredited testing agency.

7.2.2 Construction requirements

7.2.2.1 Insulating joints ≤ DN 65 can have flanges, weld or/and other metallic connections.

7.2.2.2 Insulating joints > DN 65 must not have threaded connections.

7.2.2.3 The interior creep distances and air gaps must be twice as long as the shortest, exterior creep distance.
The exterior creep distance must be at least 3 mm.

7.2.2.4 To prevent damage to the inner seal parts of the insulating joints caused by lightning or high tension interactions, appropriate construction measures must ensure that a possible electrical flash over can not occur inside the pipeline. An electrical flash-over must not affect the imperviousness of the insulating joint. In those areas where overvoltage is possible, overvoltage protection measures according to 6.2.6 and 6.2.8 must be taken.

7.2.2.5 Insulating joints made of steel must be provided with a protective coating by the factory.

7.2.2.6 When installing the insulating joints be aware of the shock protection (e.g. exterior coating).

7.2.2.7 Each insulating joint must be marked on a visible place with the nominal width (DN), the nominal pressure (PN) and the test mark with registration number of an accredited testing agency.

7.2.2.8 If necessary, insulating joints in HTB-design (higher thermic capacity 650°C for 30 min) must be installed.

7.2.3 Test conditions and tests

7.2.3.1 Strength analysis and leakage test

In the factory each insulating joint must pass a strength analysis and a leakage test carried out with air under water under a pressure of 1,5 times the nominal pressure (but at least 1 bar). The test pressure must be maintained for at least 10 minutes.

In this test the ends must be closed in a way that the axes of the insulating joint are not under pressure.

In this test leakage is not permissible.

7.2.3.2 Electrical test

When applying a test alternating voltage of 2000 V at 50 Hz there must not occur break-downs or corona discharges; the test must last at least 10 seconds. The leakage current must not exceed 3 mA.

When testing with a direct voltage of 500 V in dry conditions, the electrical resistance of the insulating joint must not be less than 100 MΩ.

8 Barrier fittings with integrated insulating joints for operating pressures of up to 4 bar

8.1 General

8.1.1 Insulating joints that are integrated in barrier fittings must be licensed by an accredited testing agency.

8.2 Construction requirements

8.2.1 When insulating joints are integrated in barrier fittings the latter must be marked, e.g. with a red ring, on that side where the insulating joint is placed.
It can also be marked with a red cap or a similar sign.

8.2.2 When the barrier fittings have a HTB-design with integrated insulating joint, also the insulating joint must have a HTB-design.

8.2.3 For the rest all the requirements of 7.2.2 shall apply.

8.3 Tests

Barrier fittings with integrated insulating joints have, in addition to the test of the fitting, to be tested according to 7.2.3.1 and 7.2.3.2. This shall apply for HTB-designs.

9 Insulating joints for control- and measuring lines

9.1 General

9.1.1 This sector only applies for factory-produced, ready-to-fit insulating joints with ≡ nominal width < DN 25.
When insulating joints must be installed in measuring and control lines ≥ DN 25, those described in sector 5, 6, 7 or 8 must be used.

9.1.2 When connecting with cutting or clamp ring screwing these must not be tested.

9.2 Construction requirements

9.2.1 Insulating joints must be designed to resist at least the nominal pressure of pipeline.

9.2.2 The following kinds of connections are permitted:

- welding end
- cutting or clamp ring screwing
- thread

9.2.3 These insulating joints need not be coated inside.

9.2.4 When installing these insulating joints be aware of the shock protection (e.g. exterior coating).

9.2.5 To prevent damage to the inner seal parts caused by to lightning or high tension interactions, construction measures of the insulating joints must ensure the overvoltage protection.

9.2.6 The interior creep distances and air gaps must be twice as long as the shortest, exterior creep distance.
The thickness of the insulating material must be at least 8 mm.

9.2.7 Each insulating joint must be marked on a visible place with the following information:

- manufacturer and/or registered trade-mark
- nominal width (DN) and nominal pressure (PN)
- type designation.

9.2.8 If a test mark of an accredited testing agency is available the marking mentioned above is unnecessary when the registration number is engraved and the registration certificate is handed over.

9.2.9 All qualities must be proved in writing. A test mark of an accredited testing agency is equivalent.

9.3 Test conditions and tests

9.3.1 In the factory each insulating joint must pass a strength analysis and leakage test carried out with air under water under a pressure of 1,5 times the nominal pressure. The test pressure must be maintained for at least 10 minutes.

9.3.2 When applying a test alternating voltage of 2000 V at 50 Hz there must not occur break-downs or corona discharges. The test must last at least 1 minute. The leakage current must not exceed 3 mA.

9.3.3 When testing with a direct voltage of 500 V in dry conditions the electrical resistance of the insulating joint may not be less than 100 MΩ.

10 Ready-to-fit insulating flange joints

10.1 General

10.1.1 The insulating flange joint is an electrically insulating, non-positive flange joint, that is pre-fitted in the factory.

10.1.2 The pressure class of the insulating flange only depends on the pressure class of both flanges.

10.1.3 For every type of construction or for a modification of the original construction plan, a prototype testing by an authorised testing agency (accredited testing laboratory) must be proved.

10.1.4 The components of insulating flange joints must be tested. The test results must be proved in writing and presented to the customer.

10.1.5 Insulating flange joints destined for installation into gas pipelines made of steel must, according to their pressure class, correspond to EN 10208 and must be designed to resist the nominal pressure of the line.

10.1.6 When the test pressure of the line does not exceed the test pressure of the insulating flange joint, the latter can also be installed into the line before the pressure of this line is tested.

10.1.7 When installing the insulating flange joint be aware of the shock protection (e.g. exterior coating)

10.1.8 After the pneumatic and leakage test of the pipeline the electrical insulating capacity of the insulating flange joint must be tested according to fig. 11 and 12.

10.2 Construction requirements

10.2.1 The ready-to-fit insulating flange joint generally consists of:

- two pre-welded flanges
- insulating parts (disks and cases)
- bolts, nuts, shims
- sealings
- welded pipe parts or flanges

10.2.2 The non-productive insulating flange joint that is pre-fitted in the factory must be installed into the pipeline without disassembly.

10.2.3 For the insulating parts of the insulating flange joint a composite layer material with high compressive strength and good dielectrical qualities must be used.

10.2.4 The material for the pressure loaded parts must correspond to the EN 10208.

10.2.5 The insulating flange joints must be sealed by flat sealings or O-ring-sealings.

10.2.6 The customer has to specify the desired steel quality of the welding ends.

10.2.7 The welding ends have to be designed corresponding to EN 10208-1, table 10.

10.2.8 The insulating flange joint must be designed for a minimum temperature range of the medium from - 10°C up to + 50°C. Differing temperatures must be specified by the customer.

10.2.9 To prevent damage to the inner seal parts of the insulating flange joints owing to lightning or high tension interactions, appropriate construction measures must ensure that ■ possible electrical flash over can not occur inside the pipeline. An electrical flash over must not affect the imperviousness of the insulating flange joint.

10.2.10 In order to protect an insulating flange joint against flash overs owing to lightning and high tension interactions an overvoltage protection device with ■ maximum operating impulse voltage according to half of the test voltage (withstand alternating voltage) of the insulating flange joint and with a leakage impulse current of 50 kA (waveform 10/350 µs corresponding to IEC 1024-1 and IEC 1312-1) must be provided.

10.2.11 The overvoltage protection device should be fixed directly on the insulating joint (maximum loop length 300 mm). In special cases the overvoltage protection device can be fixed above ground at an accessible measuring point if the lengthened line feed is designed with the lowest impedance possible corresponding to the determined length of the loop. To be efficient the overvoltage protection device must be connected with the insulating joint with a maximum connection inductance of 0,3 µH. This can be obtained by using a maximum loop length of 300 mm or other line feeds with low impedance, e.g. co-axial cables, drilled lines, etc. whose total inductance does not exceed 0,3 µH and is resistant to high lightning current (at least 16 mm^2 Cu according to IEC 1024-1)

10.2.12 If the insulating flange joint is placed in an explosive gas atmosphere ■ surge arrester with the respective licensing corresponding to EN 50014 must be used. In this case it is important to consider that the connection on the insulating flange joint also has to be explosions-proof.

10.2.13 Each insulating flange joint must be marked on a visible place with the following information:

- make
- type designation
- serial number or acceptance number
- nominal width (DN) and nominal pressure (PN)
- mark of the testing agency or of the tester.

When using pipe parts that are welded on both sides also the steel quality of these pipe ends must be marked.

10.3 Test conditions and tests

10.3.1 Strength analysis

In the factory each insulating flange joint must pass ■ water pressure test carried out under ■ pressure of 1,5 times the nominal pressure for least 5 minutes. In this test the ends must be closed in a way that the axes of the insulating flange joint are not under pressure.

The procedure of the strength analysis can be agreed between the customer and the manufacturer.

10.3.2 Leakage test

After the water pressure test, a leakage test must be carried out with air under a pressure of 5 bar for a period of at least 10 minutes before self-polishing. In this test leakage is not permissible.

10.3.3 Electrical test

Each insulating flange joint must be tested in dry conditions with a minimum voltage of 5000 V~(50Hz) for 1 minute. During the test there must not occur a corona discharge or an insulation fault.

The maximum leakage current (at 5000 Volt, 50 Hz) depends on the capacity of the relevant insulating flange joint (type, size, nominal width, pressure stage, etc.). For the recommended values for the maximum leakage current see table 1.

After the water pressure test the insulation resistance of the dry insulating flange joint must be at least 0,1 MΩ when measuring with a direct voltage of at least 500 V. After a drying period of 5 hours at room temperature a value of at least 100 MΩ must be achieved.

10.3.4 External coatings made in the factory have to resist a non-porosity test with an alternating voltage of 25 000 V.

10.3.5 The attestation of the non-porosity test of the exterior coating can also be integrated in the test certificate of the insulating flange joint.

10.3.6 The conformity with the desired qualities and the data corresponding to 10.2.13 must be attested according to EN 10204 with an acceptance test certificate 3.1.B 3.1.A or 3.1.C for pressures of over 16 bar.

10.3.7 When using for the open pipe ends steel qualities with a yield point of > 360 N/mm², an acceptance test certificate 3.1.A or 3.1.C according to EN 10204 is required for the pipe material.

11 Insulating flange pairs

11.1 General

11.1.1 The insulating flange pair is an electrically insulating, non-positive flange joint that is pre-fitted in the factory and must be taken apart in order to weld it into the gas pipeline.

11.1.2 The pressure class of the insulating flange joints only depends on the pressure class of the both flanges.

11.1.3 For every type of construction or for a modification of the original construction plan, a prototype testing by an authorised testing agency (accredited testing laboratory) must be proved.

11.1.4 The components of an insulating flange pairs must be tested. The test results must be proved in writing and presented to the customer.

11.1.5 Insulating flange pairs destined for installation into gas pipelines made of steel must, according to their pressure class, correspond to EN 10208 and must be designed to resist the nominal pressure of the line.

11.1.6 When the test pressure of the line does not exceed the test pressure of the insulating flange pair, the latter can also be installed into the line before the pressure of this line is tested.

11.1.7 When installing the insulating flange pairs be aware of the shock protection (e.g. exterior coating)

11.1.8 After the pneumatic and leakage test of the pipeline the electrical insulating capacity of the insulating flange pair must be tested according to fig. 11 and 12.

11.2 Construction requirements

11.2.1 The ready-to-fit insulating flange pair generally consists of:

- two pre-welded flanges
- insulating parts (disks and cases)
- bolts, nuts,shims
- sealings

11.2.2 The insulating flange pair that is pre-fitted in the factory must be disassembled before welding it into the pipeline, in order to avoid the destruction of the insulating and sealing material.

11.2.3 For the insulating parts of the insulating flange pair a composite layer material with high compressive strength and good dielectrical qualities must be used.

11.2.4 The material for the pressure-loaded parts must comply with the EN 10208.

11.2.5 The insulating flange pairs must be sealed by flat sealings or O-ring sealings.

11.2.6 The insulating flange pair must be designed for a minimum temperature range of the medium from - 10°C up to + 50°C. Differing temperatures must be specified by the customer.

11.2.7 To prevent damage to the inner seal parts of the insulating flange pair owing to lightning or high tension interactions, appropriate construction measures must ensure that a possible electrical flash over can not occur inside the pipeline. An electrical flash over must not affect the imperviousness of the insulating flange pair.

11.2.8 To protect an insulating flange pair against flash overs owing to lightning and high tension interactions an overvoltage protection device with a maximum operation impulse voltage according to the half of the test voltage (withstand alternating voltage) of the insulating flange pair and with a leakage impulse current of 50 kA (waveform 10/350 µs corresponding to IEC 1024-1 and IEC 1312-1) must be provided.

11.2.9 The overvoltage protection device should be fixed directly on the insulating joint (maximum loop length 300 mm). In special cases the overvoltage protection device can be fixed above ground at an accessible measuring point if the lengthened line feed is designed with the lowest impedance possible corresponding to the determined length of the loop. To be efficient the overvoltage protection device must be connected with the insulating joint with a maximum connection inductance of 0,3 µH. This can be obtained by using a maximum loop length of 300 mm or other line feeds with low impedance, e.g. co-axial cables, drilled lines,

etc. whose total inductance does not exceed 0,3 µH and is resistant to high lightning current (at least 16 mm^2 Cu according to IEC 1024-1)

11.2.10 If the insulating flange pair is placed in explosive gas atmosphere a surge arrester with the respective licensing corresponding to EN 50014 must be used. In this case it is important to consider that the connection on the insulating flange pair also has to be explosions-proof.

11.2.11 Each insulating flange pair must be marked on a visible place with the following information:

- make
- type designation
- serial number or acceptance number
- nominal width (DN) and nominal pressure (PN)
- mark of the testing agency or of the tester.

11.3 Test conditions and tests

11.3.1 Strength analysis and leakage test

The strength and the imperviousness of insulating flange pairs does not need to be tested in the factory.

11.3.2 Electrical test

When applying a test alternating voltage of 5000 V at 50 Hz there must not occur breakdowns or corona discharges. The test must last at least 1 minute. The leakage current (at 5000 V, 50 Hz) depends on the capacity of the relevant insulating flange pair (type, size, nominal width, pressure stage, etc.). For the recommended values for the maximum leakage current see table 1.

When testing with a direct voltage of 500 V in dry conditions the electrical resistance of the insulating flange pair must not be less than 100 MΩ

11.3.3 The conformity with the desired qualities and the data corresponding to 11.2.must be attested according to EN 10204 with an acceptance test certificate 3.1.B 3.1.A or 3.1.C for pressures of over 16 bar.

Annex 1

1 **Arrangement and installation examples of insulating joints**

The installation of insulating joints into vertical line sections is preferred, so that an electrical bridge by conductive foreign elements inside the insulating joint will not occur.

1.1 Installation of insulating joints into house-connection lines and buried supply pipes - fig. 17 to 22.

For reason of shock protection insulating joints have to be installed into these lines made of steel in the gas flow direction immediately after the inlet and before the outlet of the building. This also applies to lines made of plactic when the transition to lines made of steel occurs in the underground.

1.2 Installation of insulating joints into buried pipelines according to chapter 5 - without illustration.

1.3 Installation of insulating joints into gas pressure regulators and into valve stations according to chapter 5 - fig. 14 to 16 and 23 to 31.

1.4 Installation of insulating joints into measurement- and control lines according to chapter 5 - fig. 8

1.5 Installation of insulating joints into pipelines on bridges according to chapter 5 - fig. 32.

2 **Location and installation of measuring cables when installing insulating joints**

2.1 Each installed insulating joint must have a measuring point on both sides.

2.2 If direct measuring is impossible measuring cables must be installed.

2.3 The measuring cables must be terminated at a measuring point. These measuring points can be installed in street-, wall- or detached boxes.

2.4 The measuring cables must not end in areas where an explosive gas atmosphere exists (unless special precautions are taken.)

2.5 If measuring cables must be buried, only double-insulated cables are permissible.

2.6 Measuring cables must not have a metal sheath and cores must not be marked with green and yellow . Moreover they must have ■ minimum diameter of 10 mm^2 CU or 2 x 4 mm^2 Cu. For cables for the exterior connection of surge arresters see chapter 5.2.7.

2.7 The transition resistance between the used measuring cables and the pipeline must be very small (some $\mu\Omega$).
Therefore the connections of the measuring cables should be manufactured by welding, soldering or special thermit welding procedures. Adhesive procedures or connections by clamps are to be avoided.

2.8 In no case may the measuring cables may be installed on the insulating joint itself or directly on the round weld (distance from the weld at least 100 mm).

2.9 Electrical connections on the surface of the pipes must be manufactured by a welding procedure that does not alter the qualities of the material. When applying thermit welding or stud welding procedures for the production of cable connections for the cathodic protection, the qualification of the welder for welding on a building site must be tested before welding. In this test it must be proved that the metallurgic structure of the pipe material is not affected through the welding of the cable.

The preparation of the pipe surface, the connection method as well as the welding can only be made by trained personnel. The adhesive strength of the welds and the integrity of the cable connections must be tested.

2.10 The connection points of the measuring cables must be suitably coated.

Annex 2

Illustrations (informative)

The following illustrations are basic examples and are not complete.

Fig. 24 Insulating joints in detached control box and/or meter case made of metal or concrete (foundation made of reinforced concrete) - house-connection line made of PE - transition to steel before inlet into the box (case)

Fig. 25 Insulating joints in detached control box and/or meter case made of metal or concrete (foundations made of reinforced concrete) - house-connection line made of PE - transition to steel immediately at the inlet into the box (case)

Fig. 26 Insulating joints in detached control box and/or meter case made of plastic (foundations made of plastic)

Fig. 27 Insulating joint in detached control box and/or meter case made of plastic (foundations made of plastic); house-connection line made of PE - transition to steel before inlet into the box (case)

Fig. 28 No insulating joint in detached control box and/or meter case made of plastic (foundations made of plastic); house-connection line made of PE - transition to steel immediately at the inlet into the box (case)

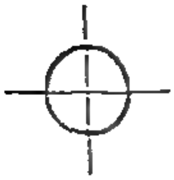
Fig. 29 Insulating joint in control box and/or meter case at or in the exterior house wall; house-connection line made of steel or PE with transition to steel before the inlet into the box (case)

Fig. 30 No insulating joint in control box and/or meter case at or in the exterior house wall; house-connection line made of steel or PE - transition to steel immediately at the inlet into the box (case)

Fig. 31 Insulating joint in control box and/or meter case at or in the exterior house wall; house-connection line made of steel or PE with transition to steel before the inlet into the box (case)- lead-in of the steel line into a building without cellar.

Fig. 32 Steel lines on bridges; interruption of the cathodic protection in bridges through installation of insulating joints (basic scheme)

LEGEND



PIPELINE

MAIN

INNER PIPELINE

EXTENSION

EXTENSION FUSE

SLEEVE

STEEL/PE JOINT

WALL ENTRANCE UNIT

INSULATING FLAGE

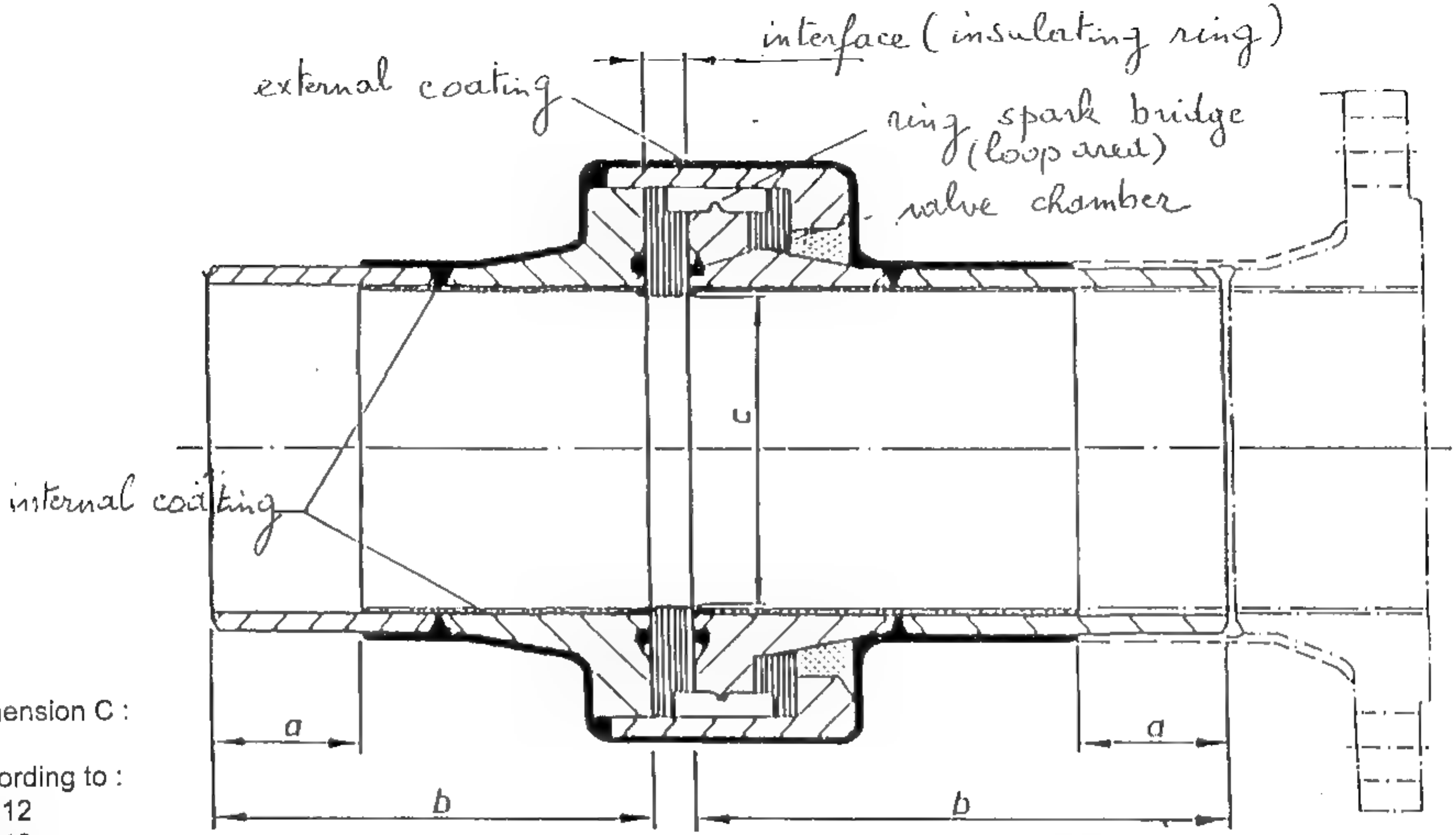
INSULATING JOINT

LOCK FITTING

LOCK FITTING WITH INTEGRATED
INSULATING JOINT

PRESSURE CONTROL DEVICE

GAS METER



Dimension C :

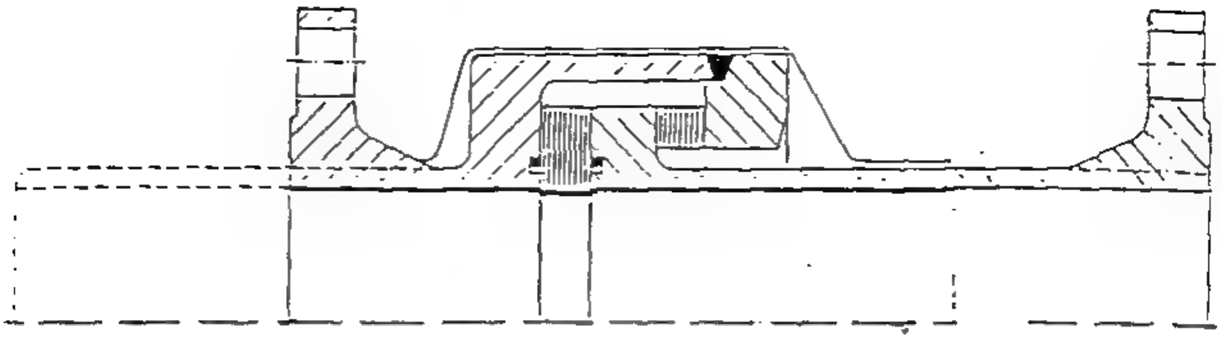
according to :
5.2.12
5.2.13
6.2.12
6.2.13

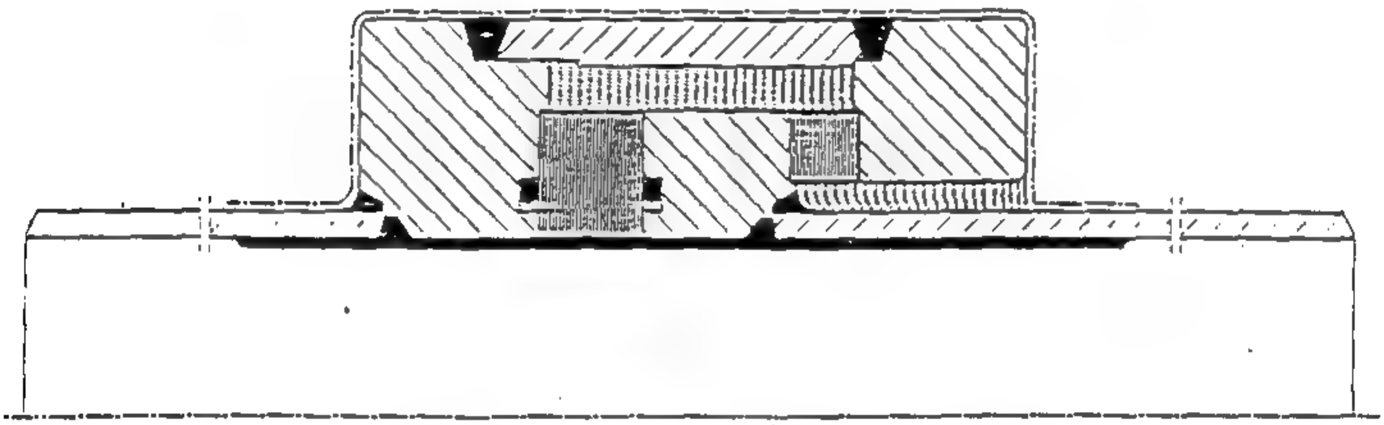
Installation options
- both sides welded extensions
- both sides flange extensions
- one side flange - one side welded extension

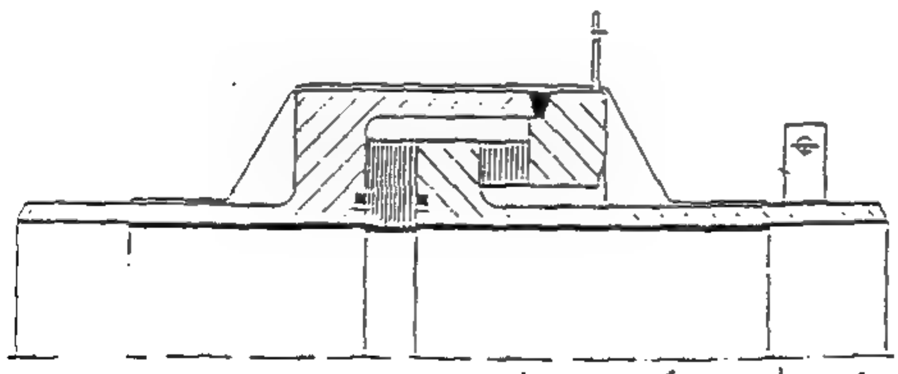
free welding end a = 150 mm
free pipe end at :
- electric welding b ≥ 100 mm
- oxyacetylene welding b≥ 250 mm

Fig. 1 General structure of a ready-to-fit insulating joint with integrated ring spark bridge

Fig. 2 Various kinds of ready-to-fit insulating joints







Insulating joint with extension for overvoltage protection

Fig. 3 Insulating joints; suitable for the aboveground installation up to DN 50 and 4 bar

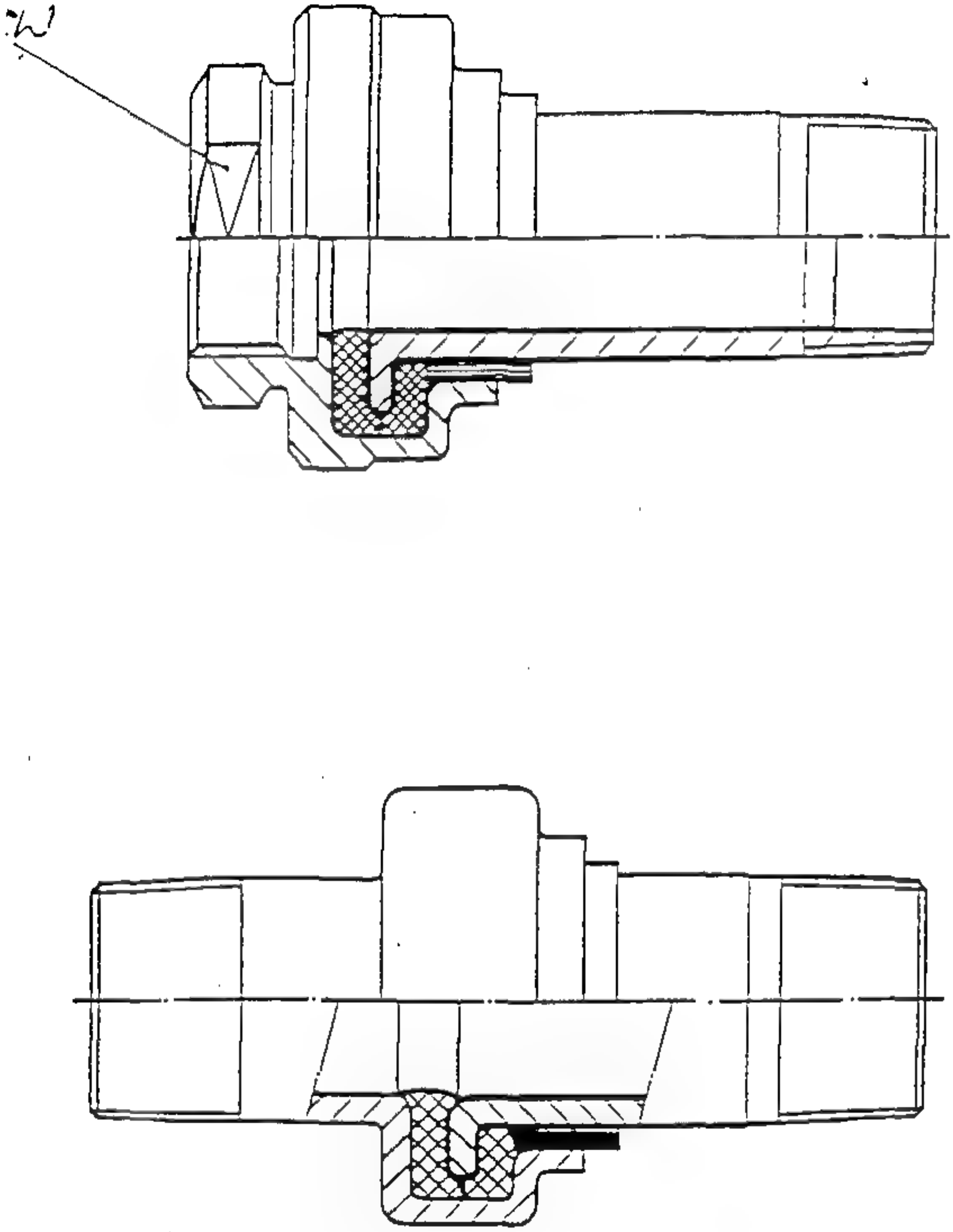


Fig. 4 Insulating joints; suitable for the aboveground installation up to 4 bar

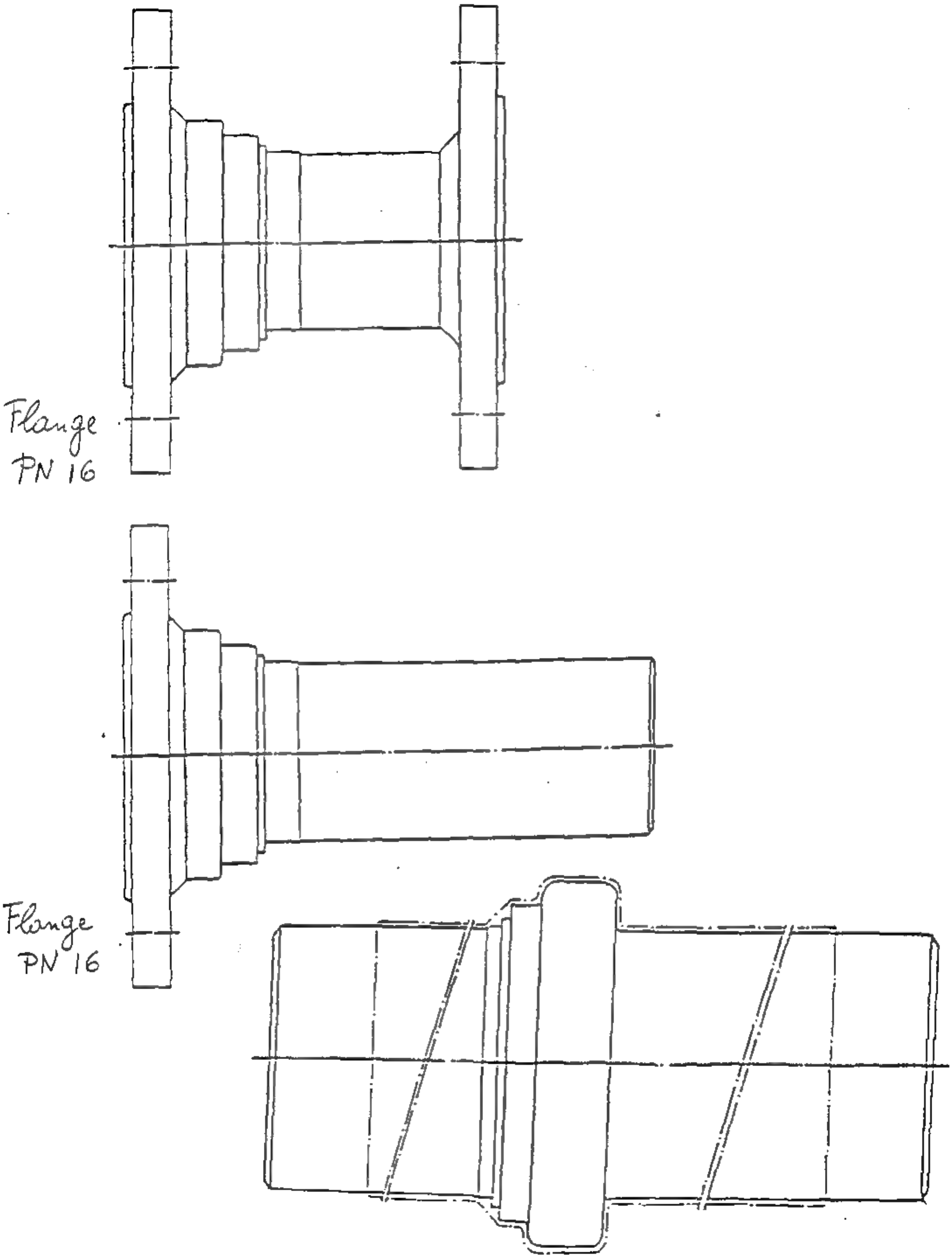
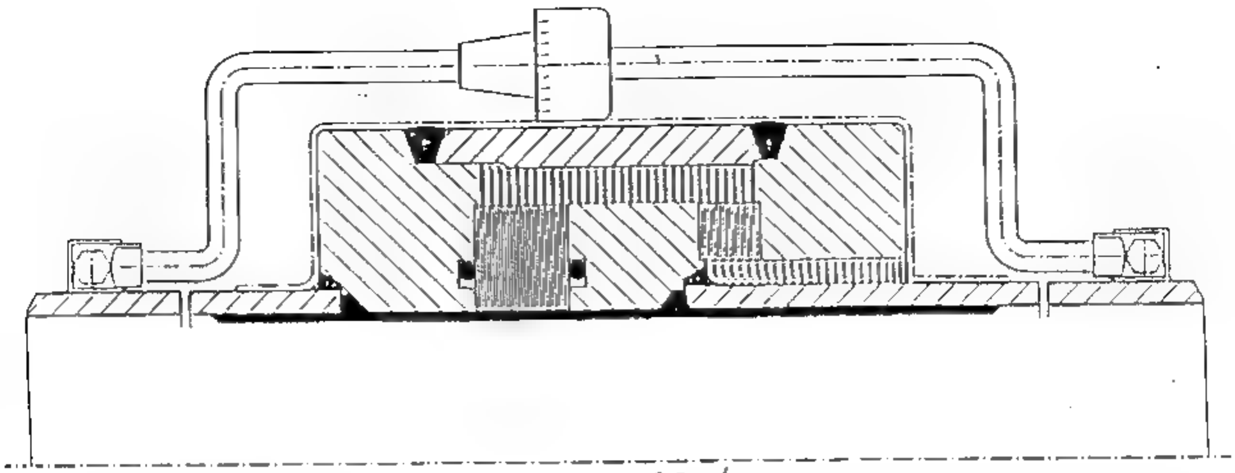
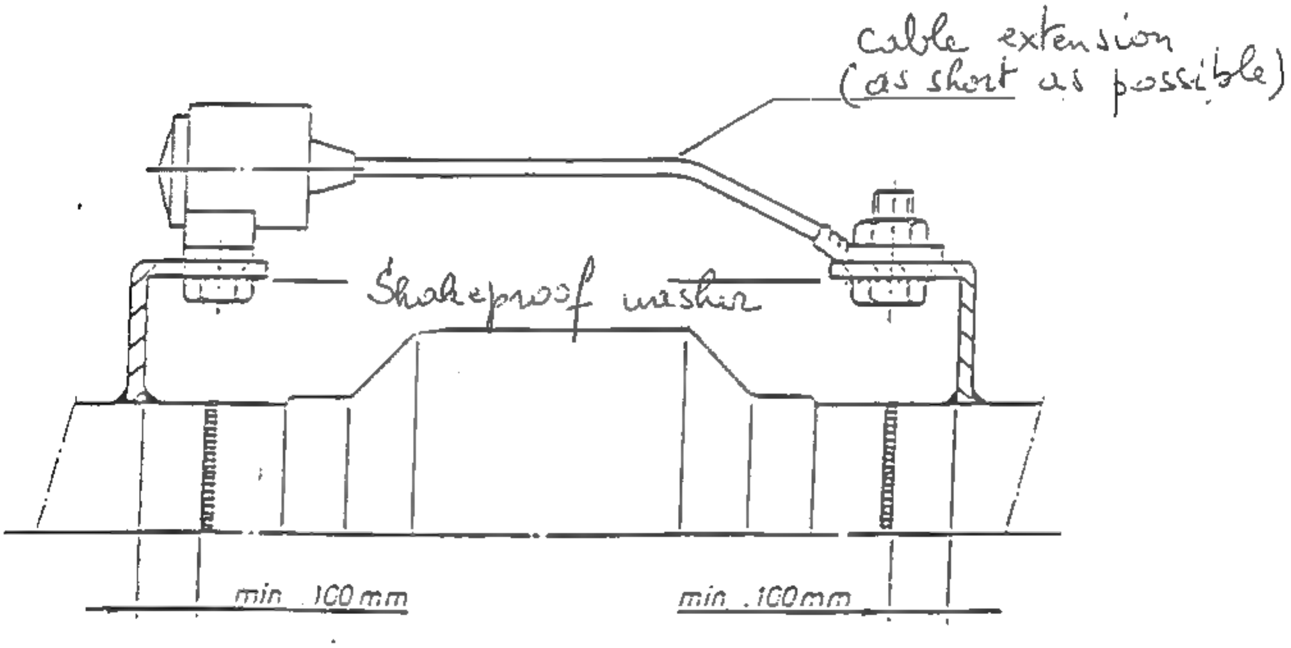


Fig. 5 Schematic description of overvoltage protection devices on insulating joints

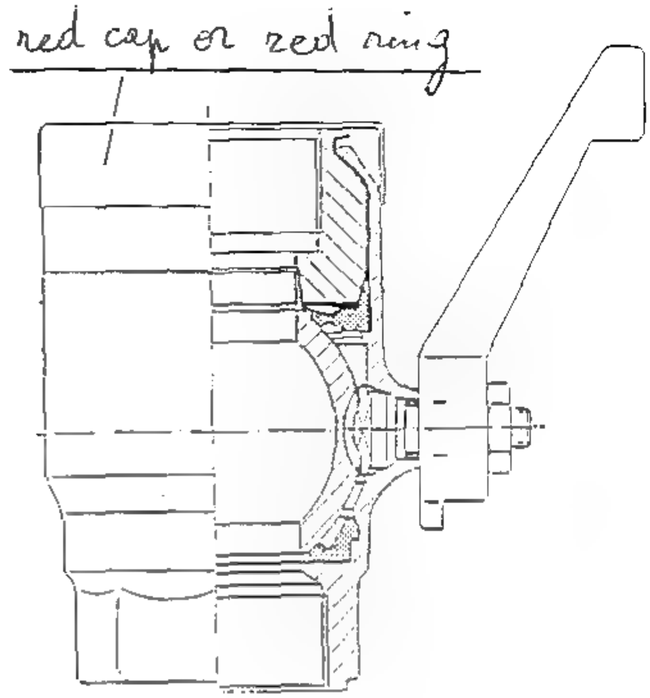


Example 1 : Factory installed

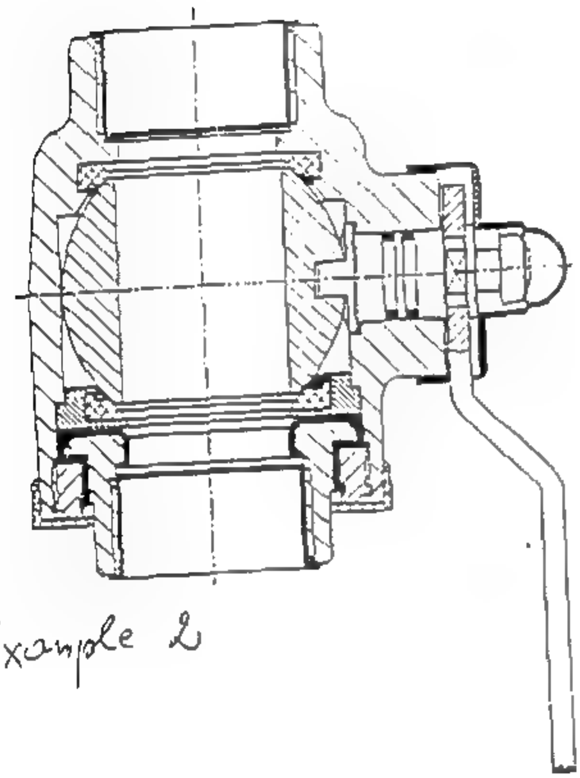


Example 2 : installed on site

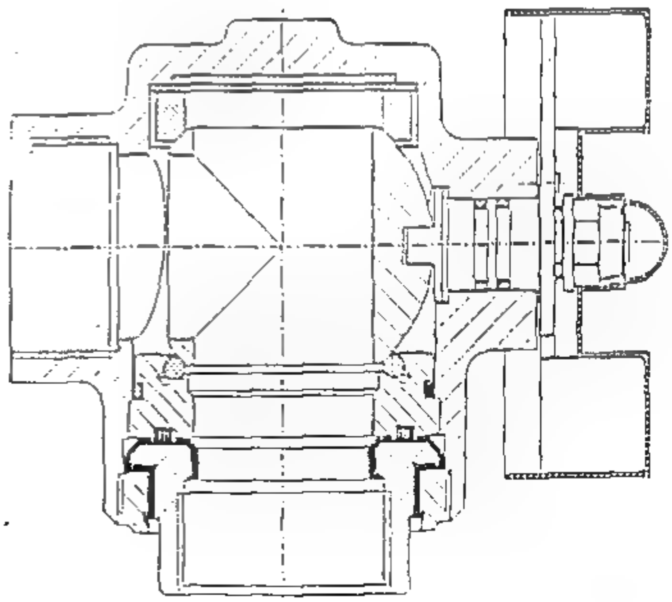
Fig. 6 Barrier fittings with integrated insulating joint for operating pressures of up to 4 bar



Example 1



Example 2



Example 3

Fig. 7 Examples for the different kinds of barrier fittings with integrated insulating joint for operating pressures of up to 4 bar

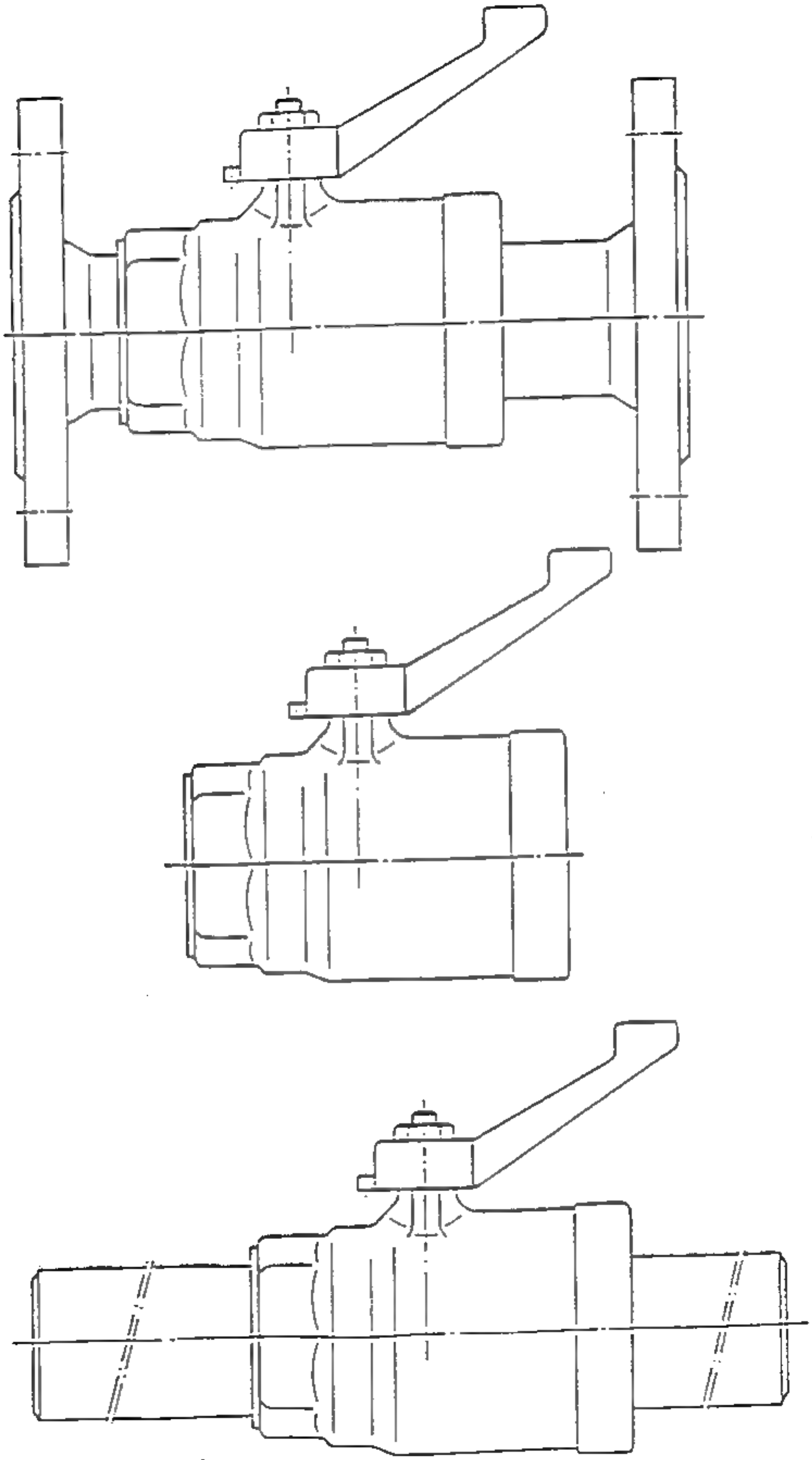
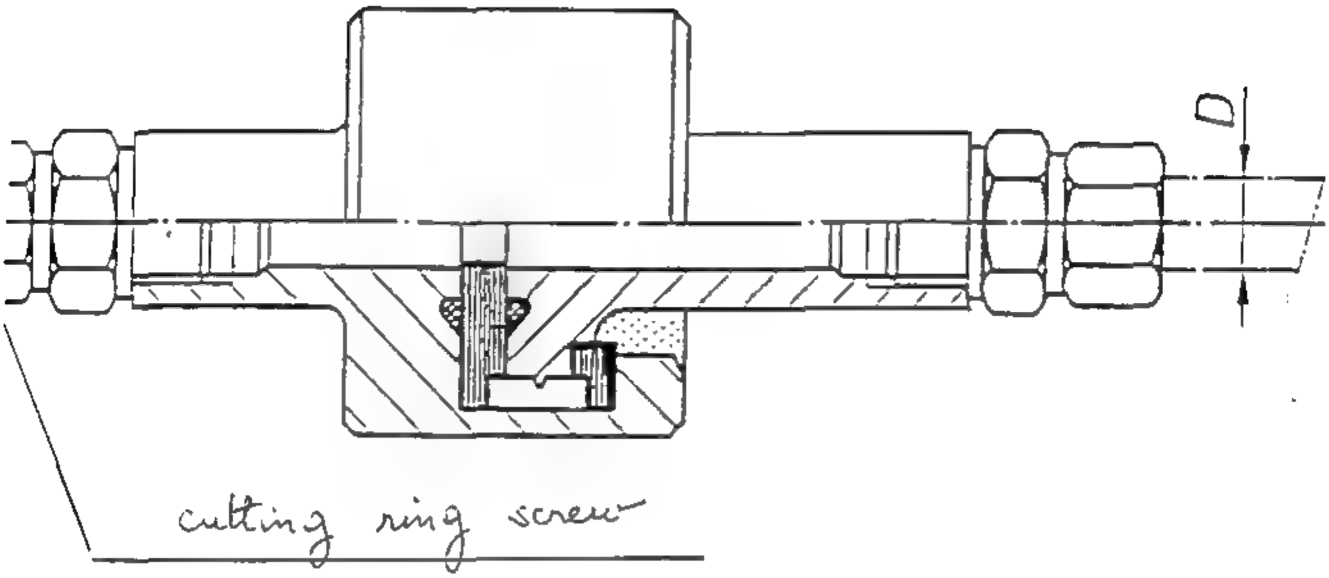
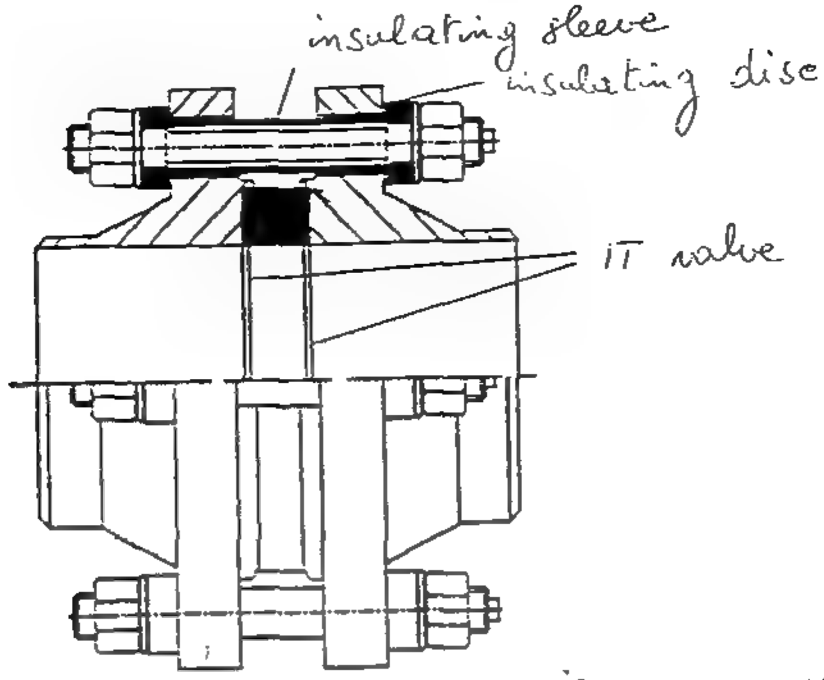


Fig. 8 Example for an insulating joint for the installation into control and measurement lines

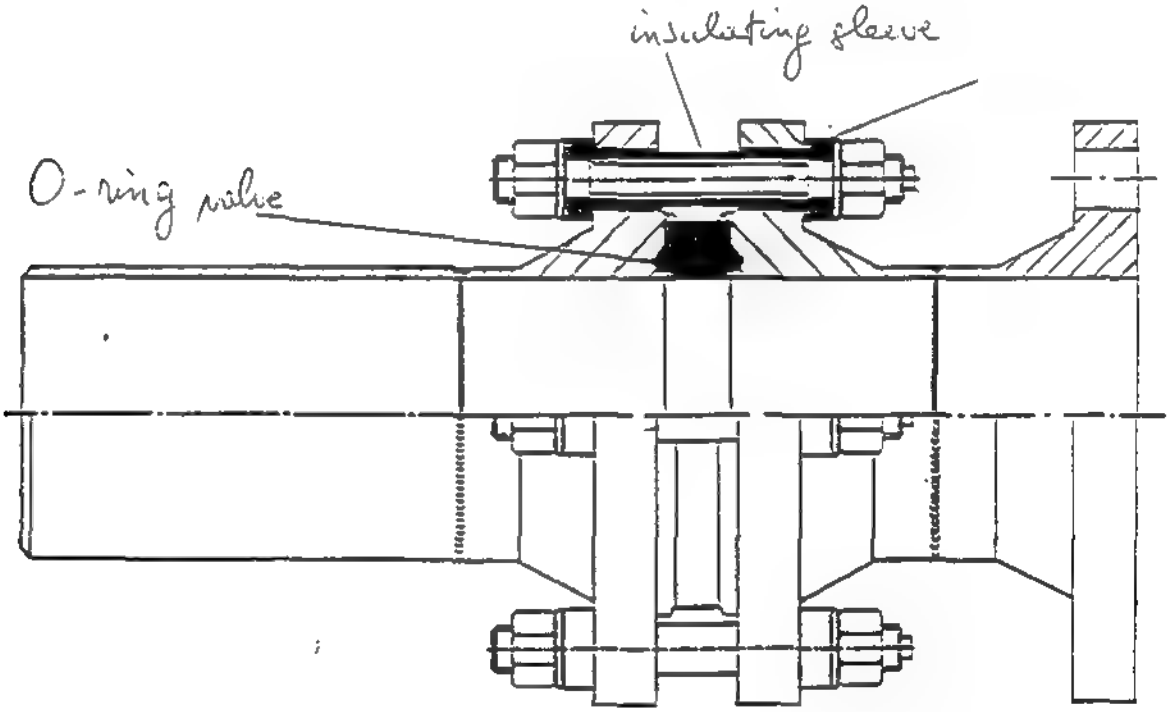


D = 6 - 8 - 10 - 12 - 16 - 20 mm

Fig. 9 Ready-to-fit Insulating flange pair



Example 1 : Prewelded flange with back twist
IT valves on both sides



Example 2 : Prewelded flange with twist and
O ring valves on both sides

Fig. 10 Insulating flange pair with overvoltage protection device

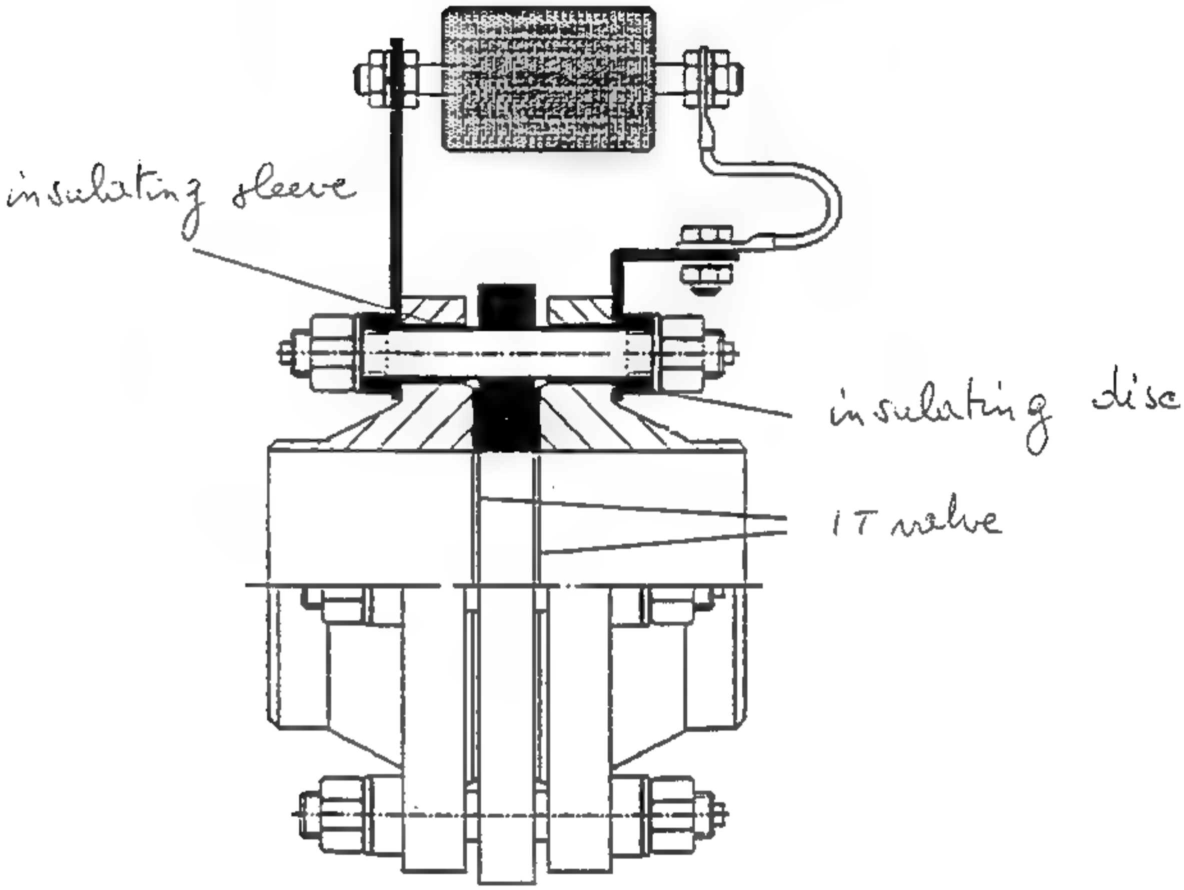
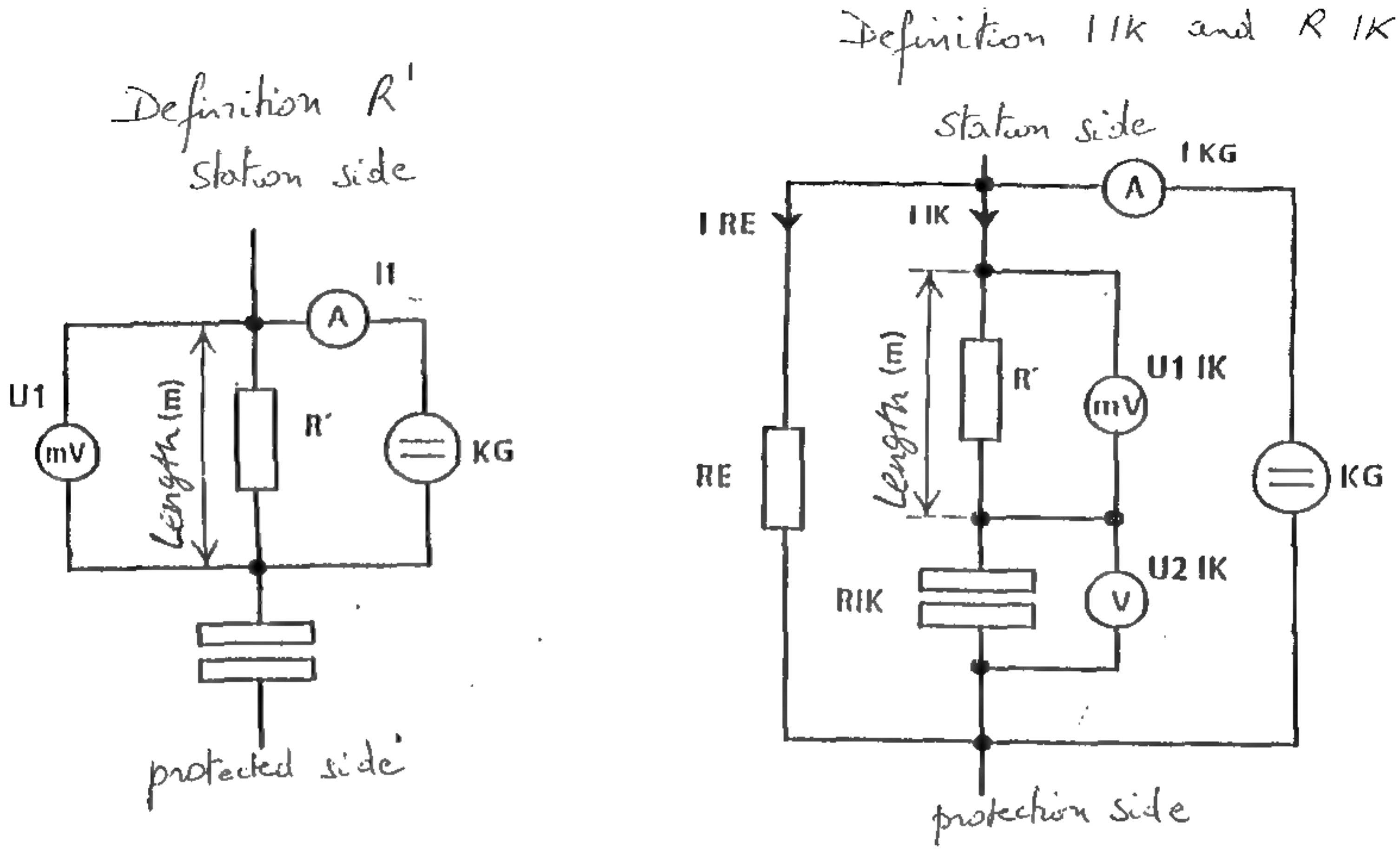


Fig. 11 Testing an insulating joint by measurement of the voltage drop



U1 potential drop at pipe
I1 pipe current
KG rectifier
R pipeline resistance

U1 IK potential drop at pipe
U2 IK difference potential
IKG rectifier voltage
Length pipe length

I IK current in insulation
R IK resistance of insulation
I RE current in the earth
RE earth resistance

Fig. 12 Testing an insulating joint by measurement of the electrical field

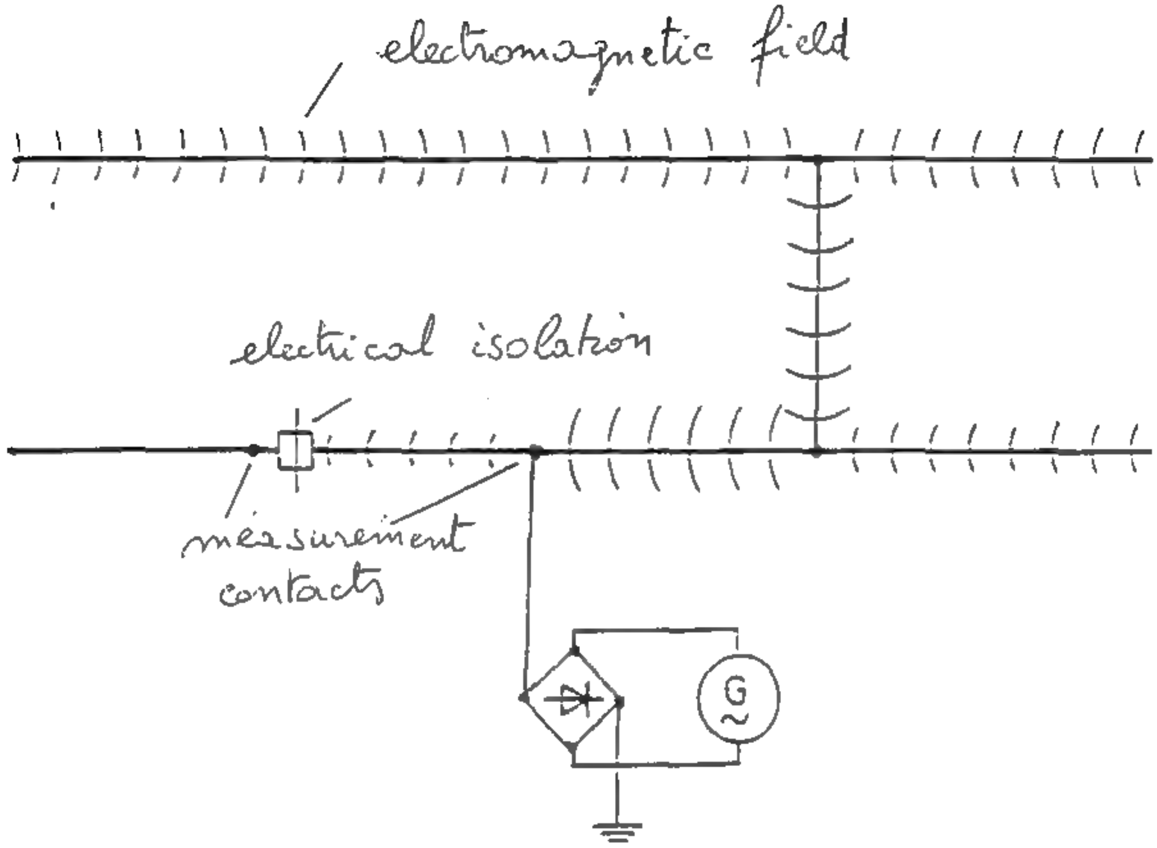


Fig. 13 Surge arrester in the measuring box

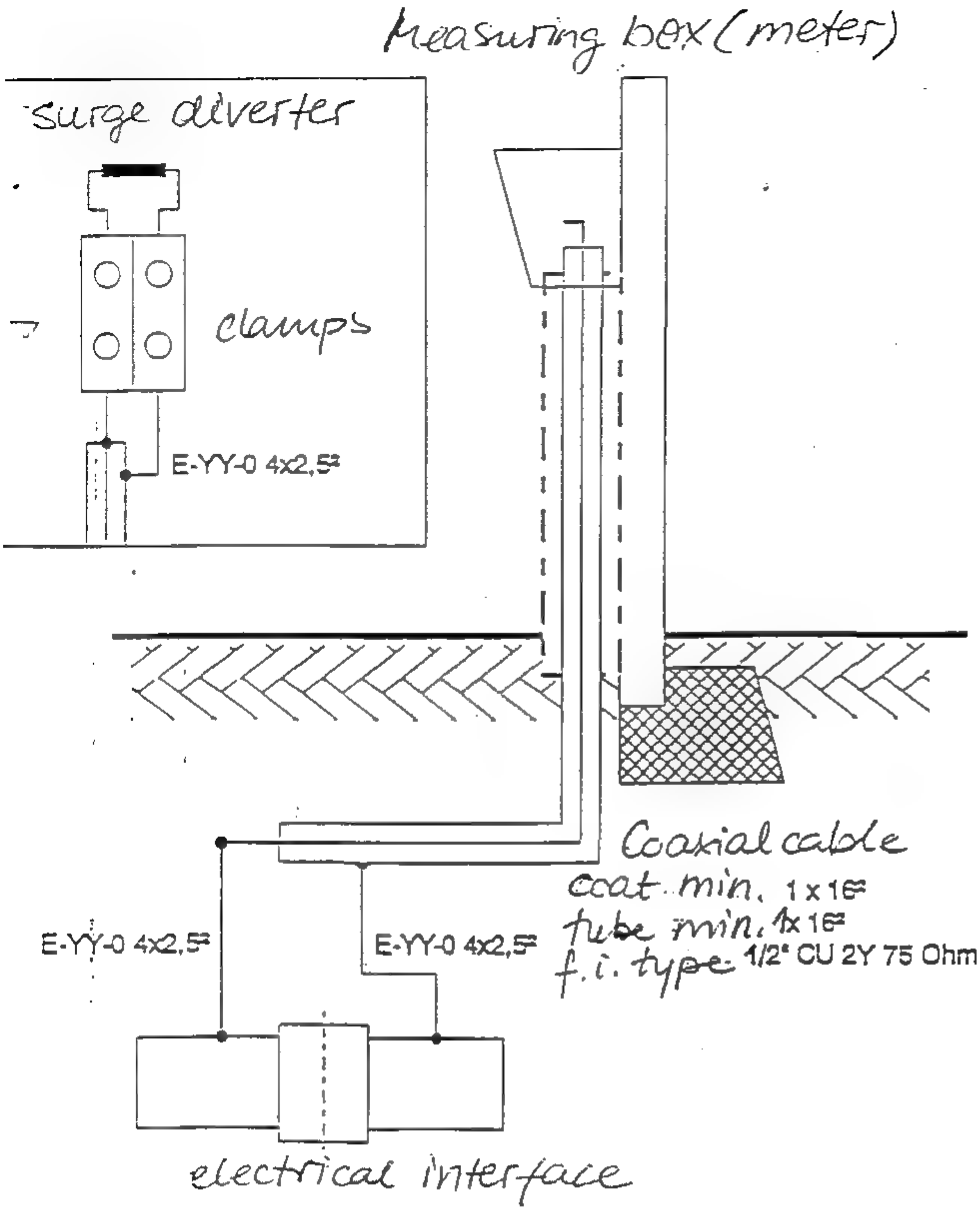


Fig. 14 Simplified circuit diagram - valve station or similar installations; no insulating joint in the main line

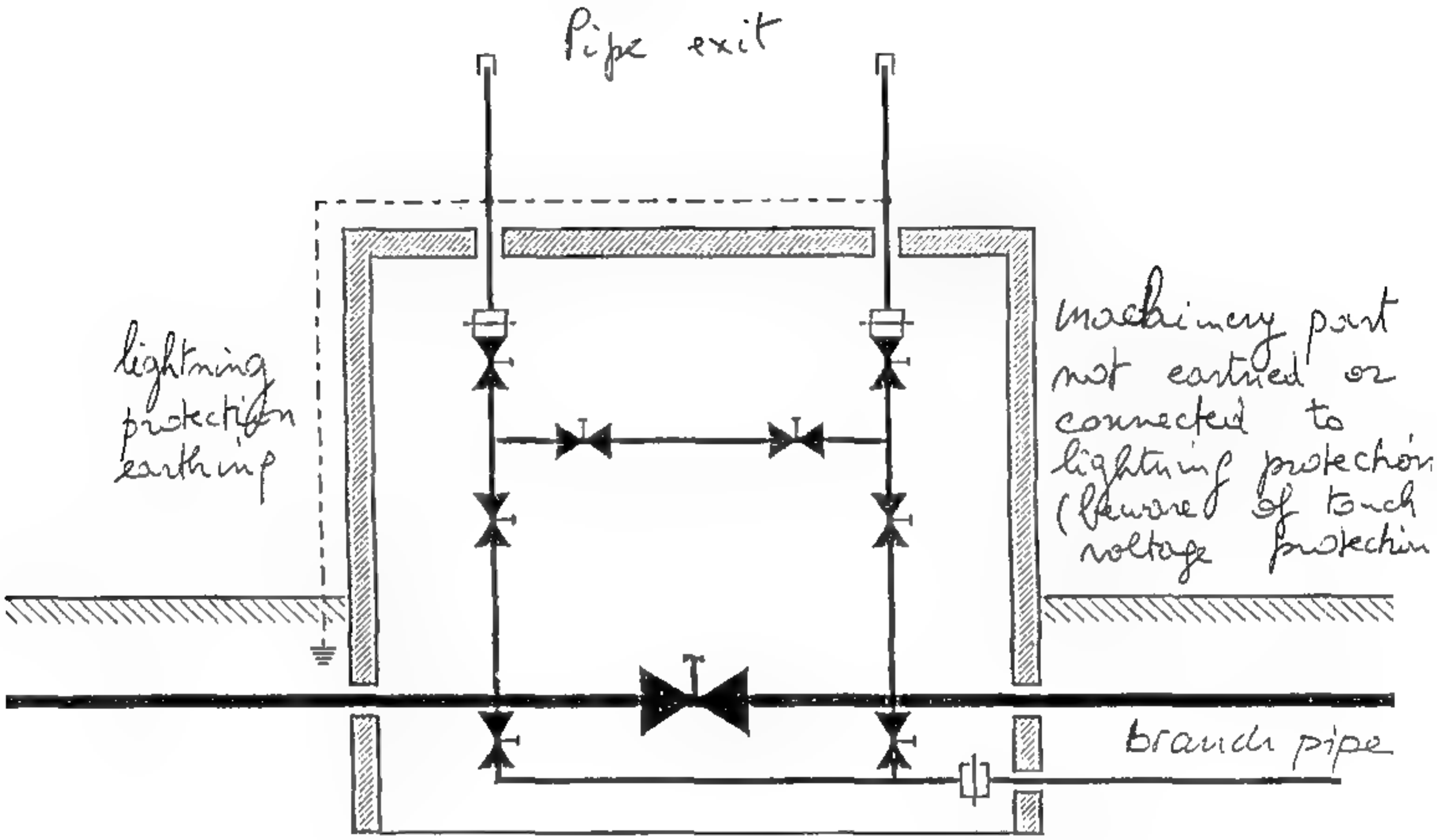


Fig. 15 Simplified circuit diagram - valve station or similar installations; insulating joint in the main line

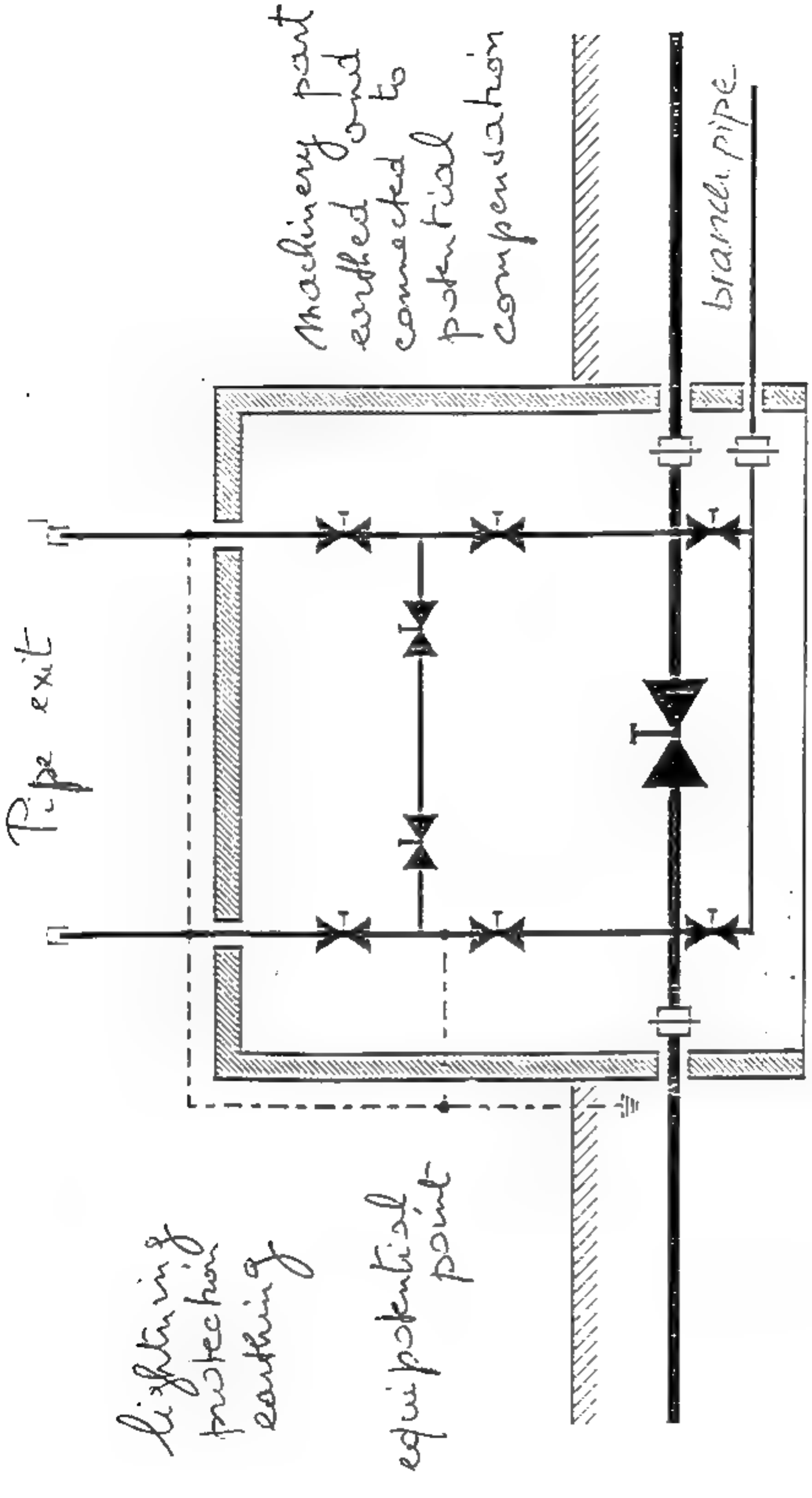


Fig. 16 Lead-in of a pipe into a building

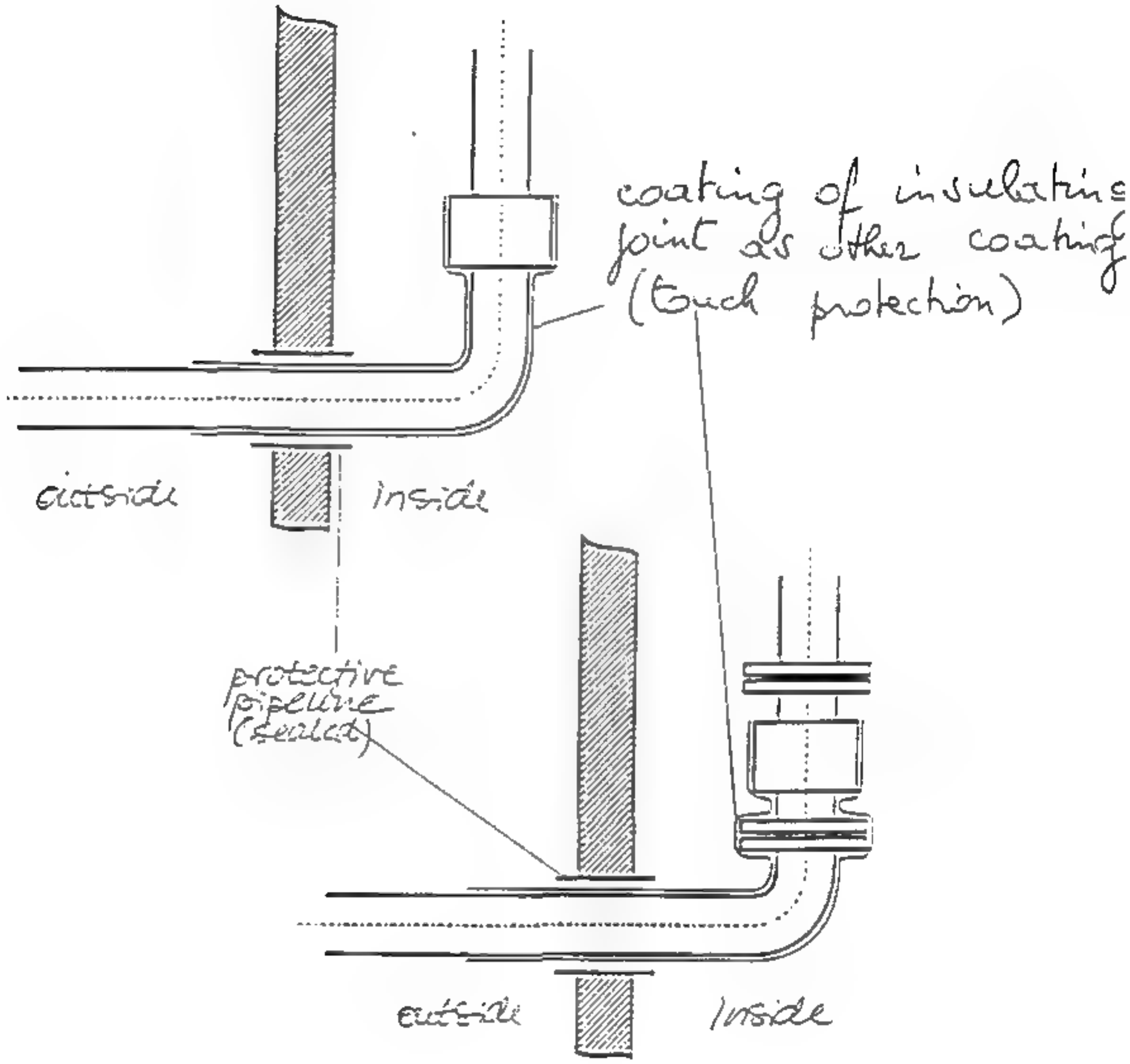


Fig. 17 Insulating joints in house-connection line; house-connection line made of steel

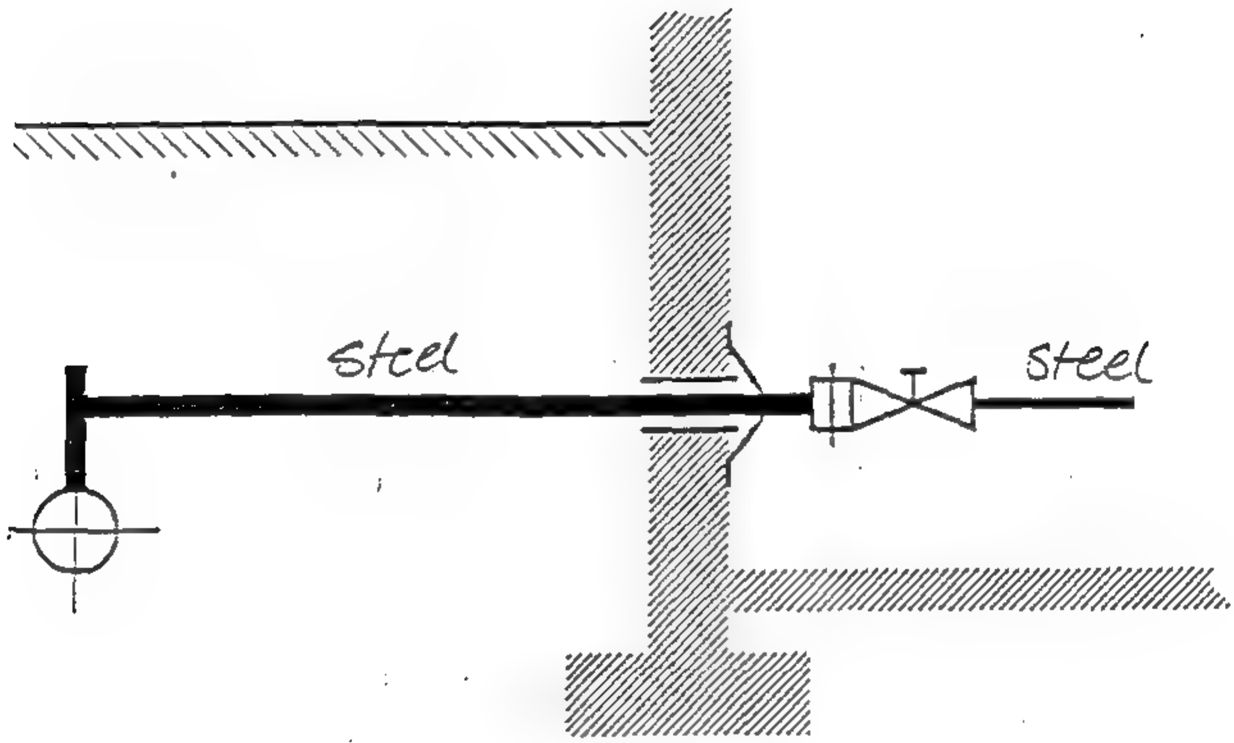


Fig. 18 No insulating joint in house-connection line; house-connection line made of PE

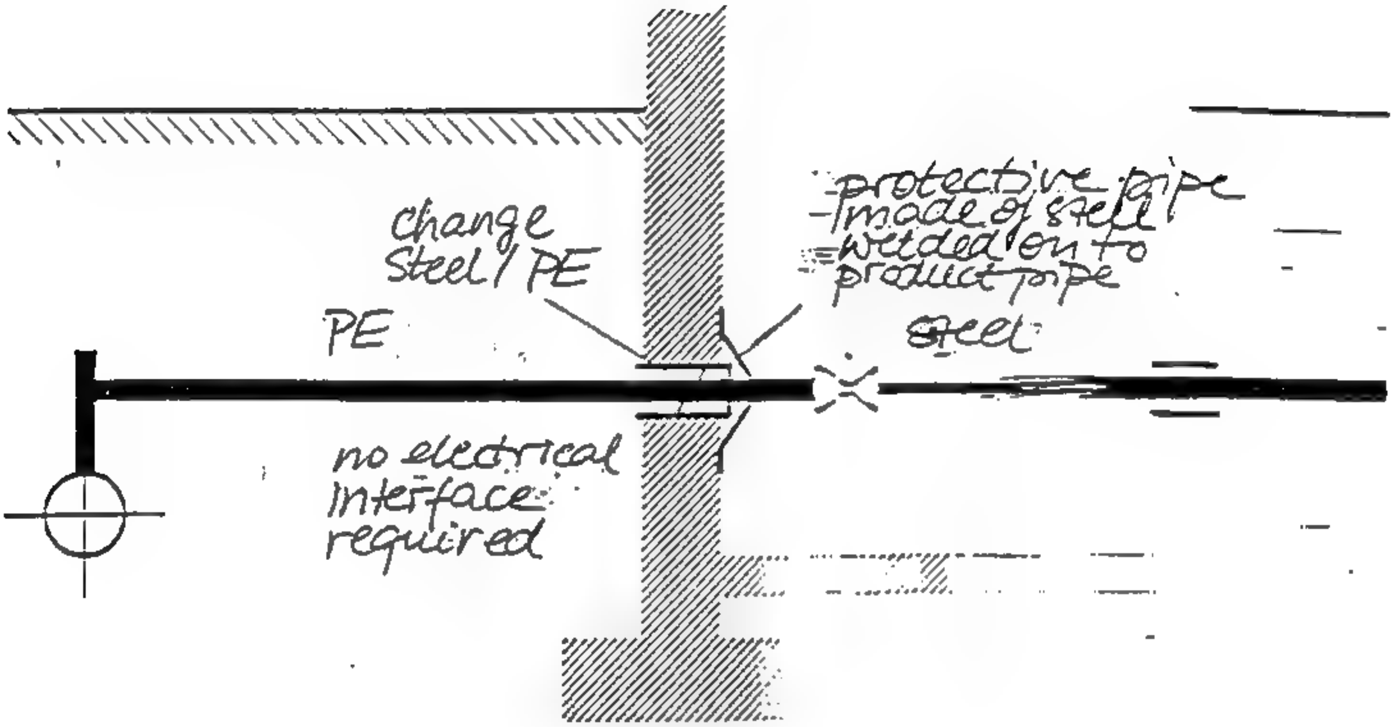


Fig. 19 Insulating joint in house-connection line; house-connection line made of PE - transition to steel before wall entrance

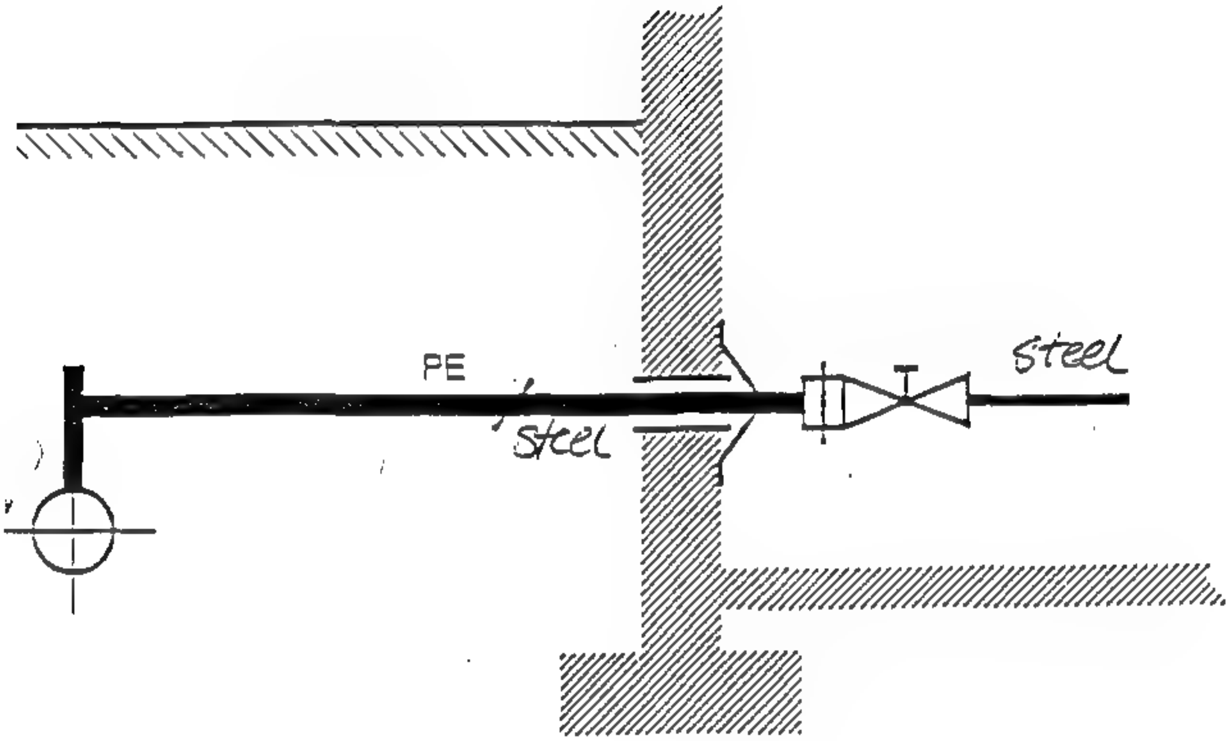


Fig. 20 No insulating joint in house-connection line; house-connection line made of PE - wall entrance unit

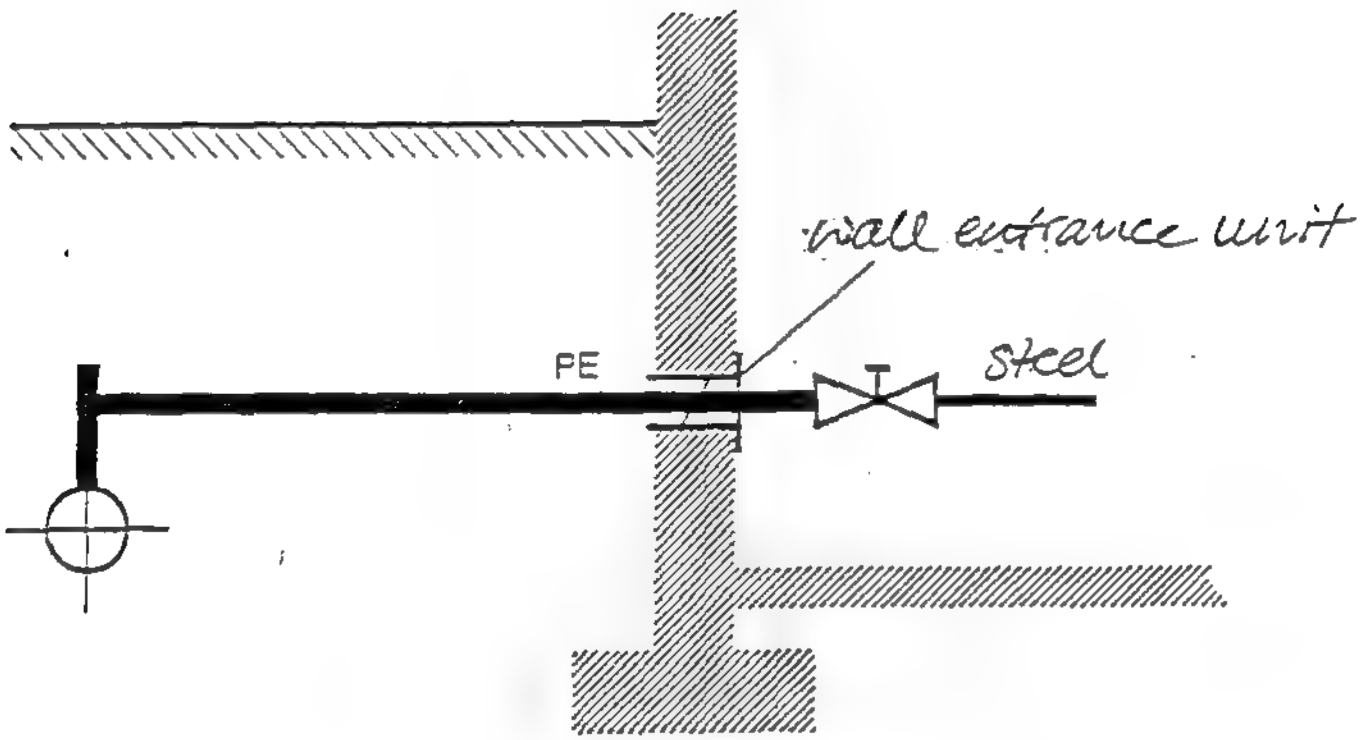


Fig. 21 Insulating joints in buried supply pipe

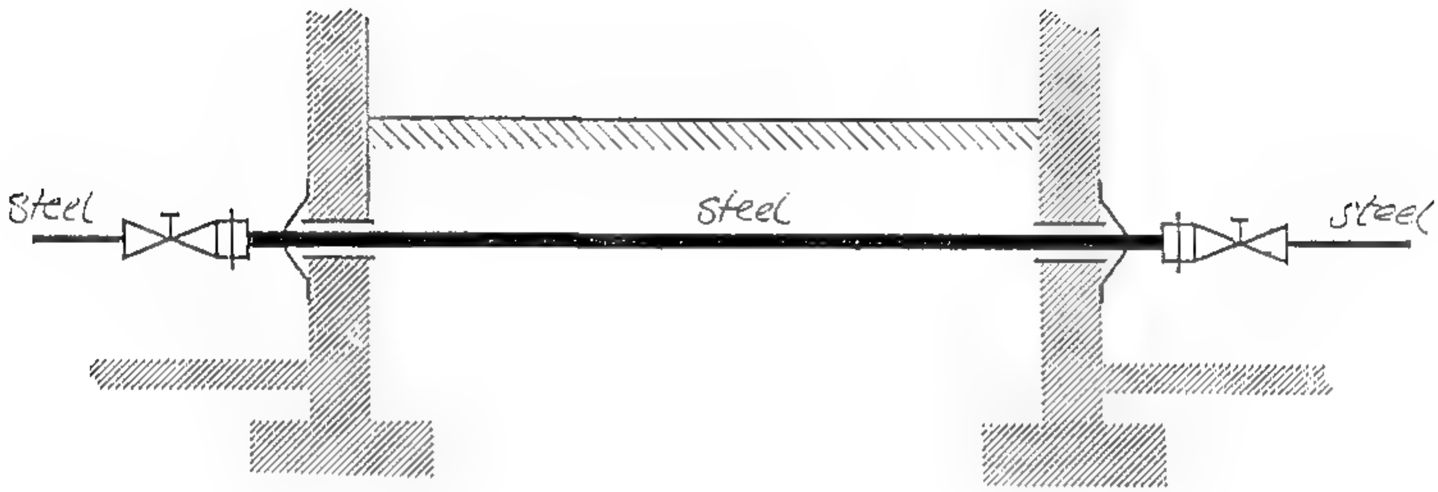


Fig. 22 Insulating joint in buried supply pipe - partly laid in pipe channel

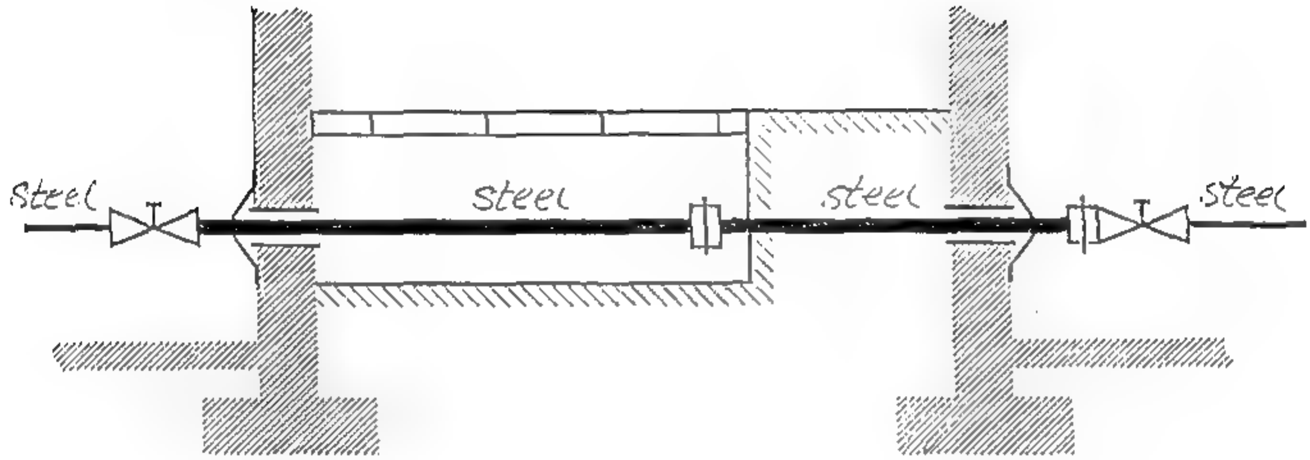


Fig. 23 Insulating joints in detached control box and/or meter case made of metal or concrete (foundation made of reinforced concrete)

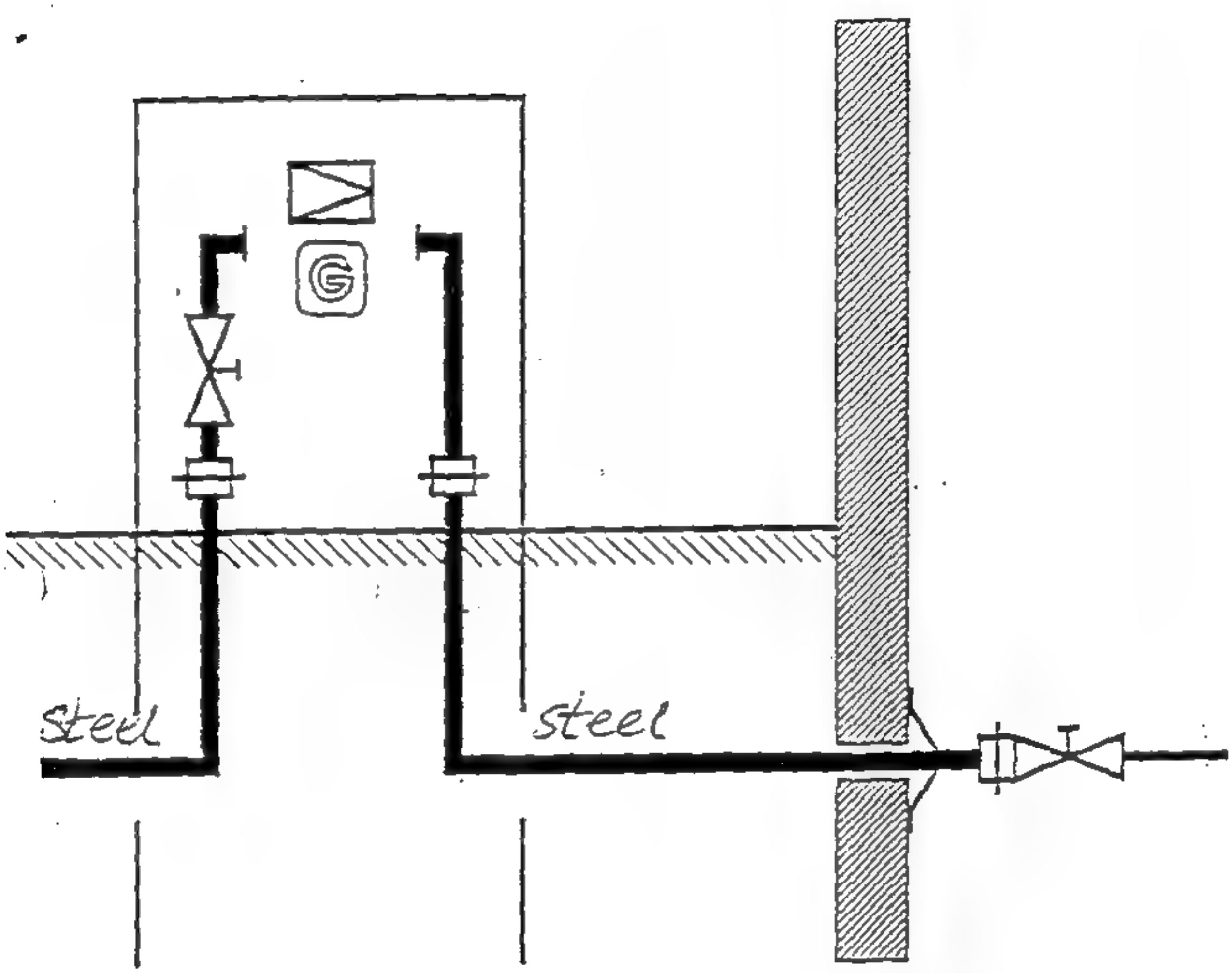


Fig. 24 Insulating joints in detached control box and/or meter case made of metal or concrete (foundation made of reinforced concrete) - house-connection line made of PE - transition to steel before inlet into the box (case)

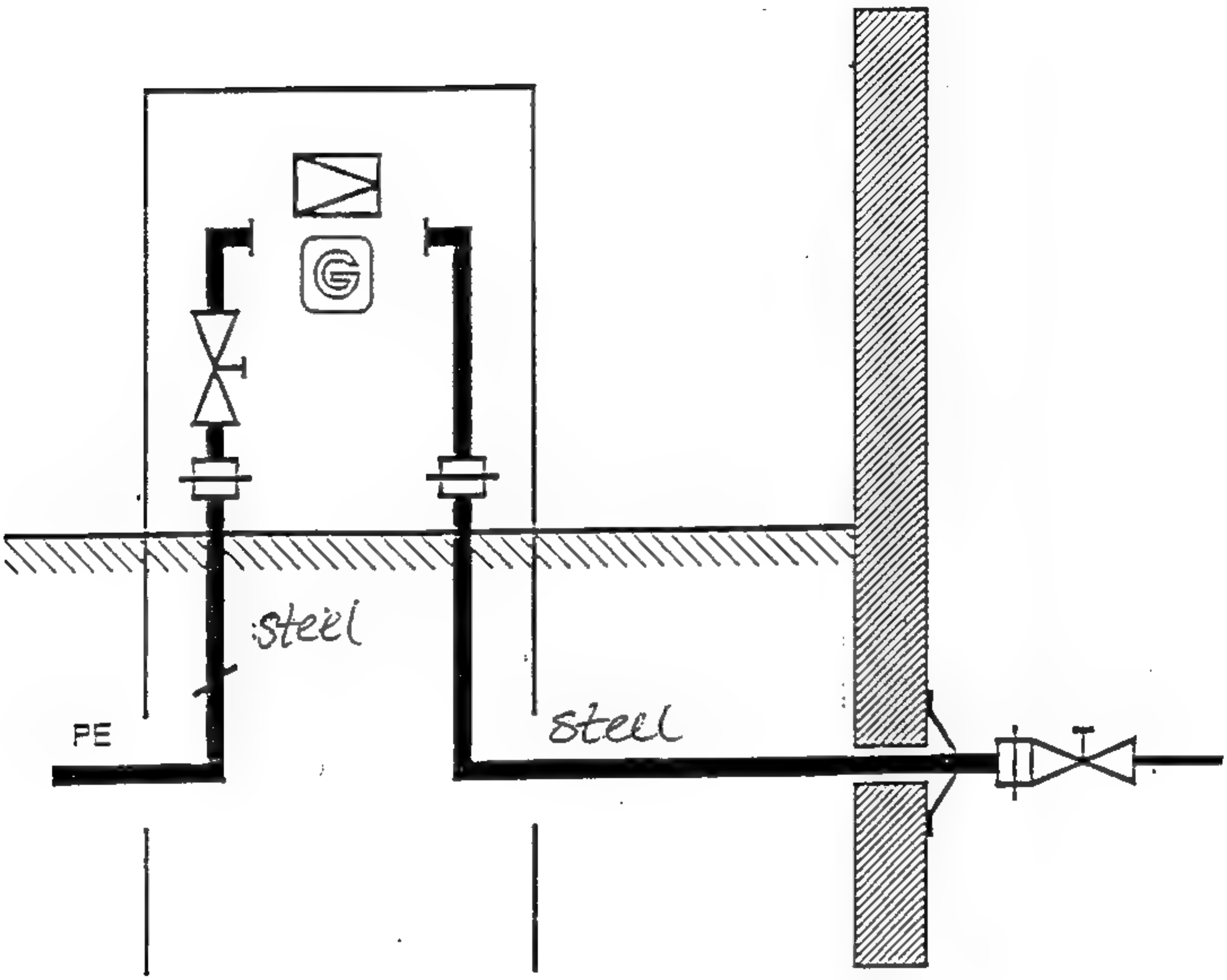


Fig. 25 Insulating joints in detached control box and/or meter case made of metal or concrete (foundations made of reinforced concrete) - house-connection line made of PE - transition to steel immediately at the inlet into the box (case)

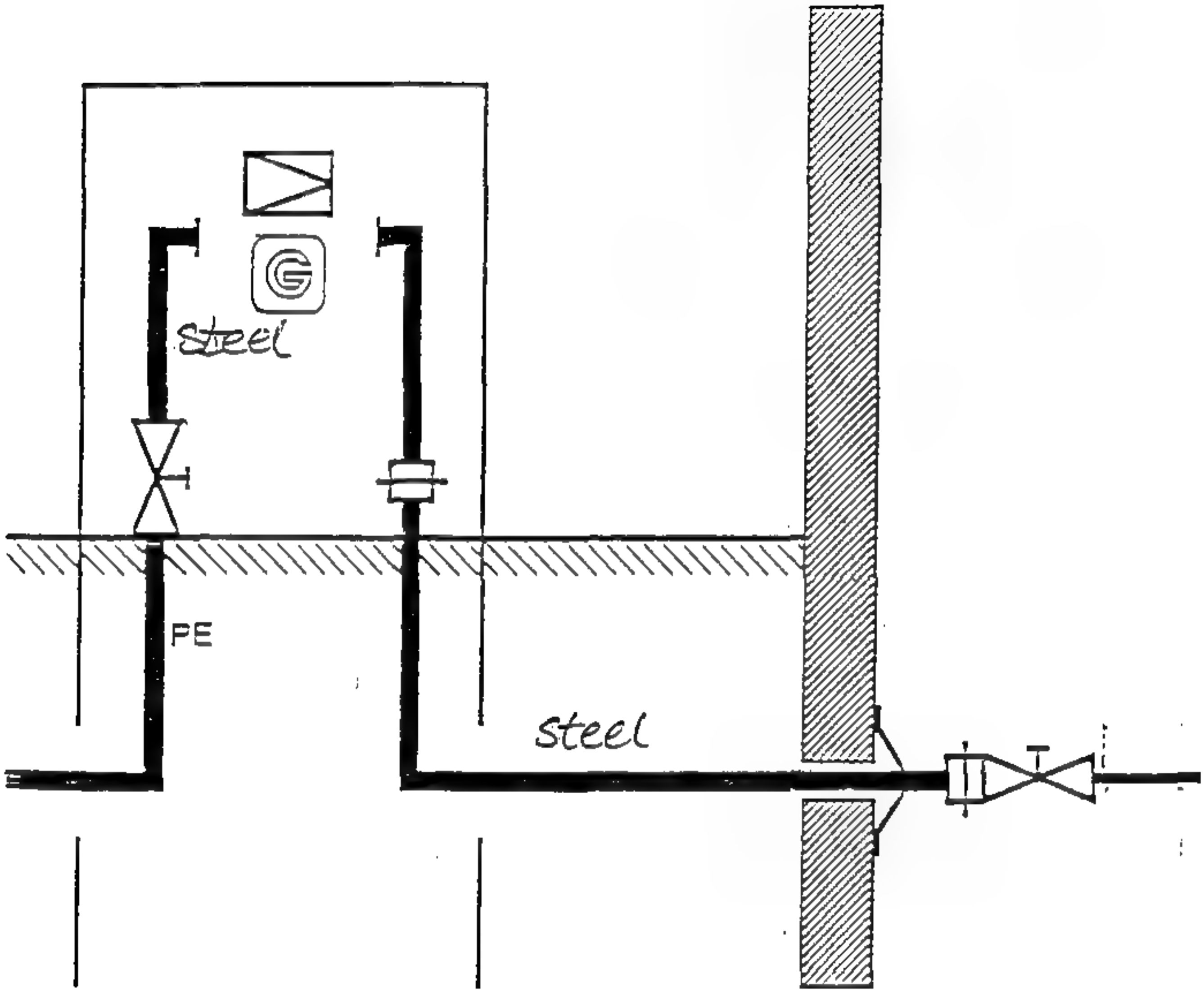
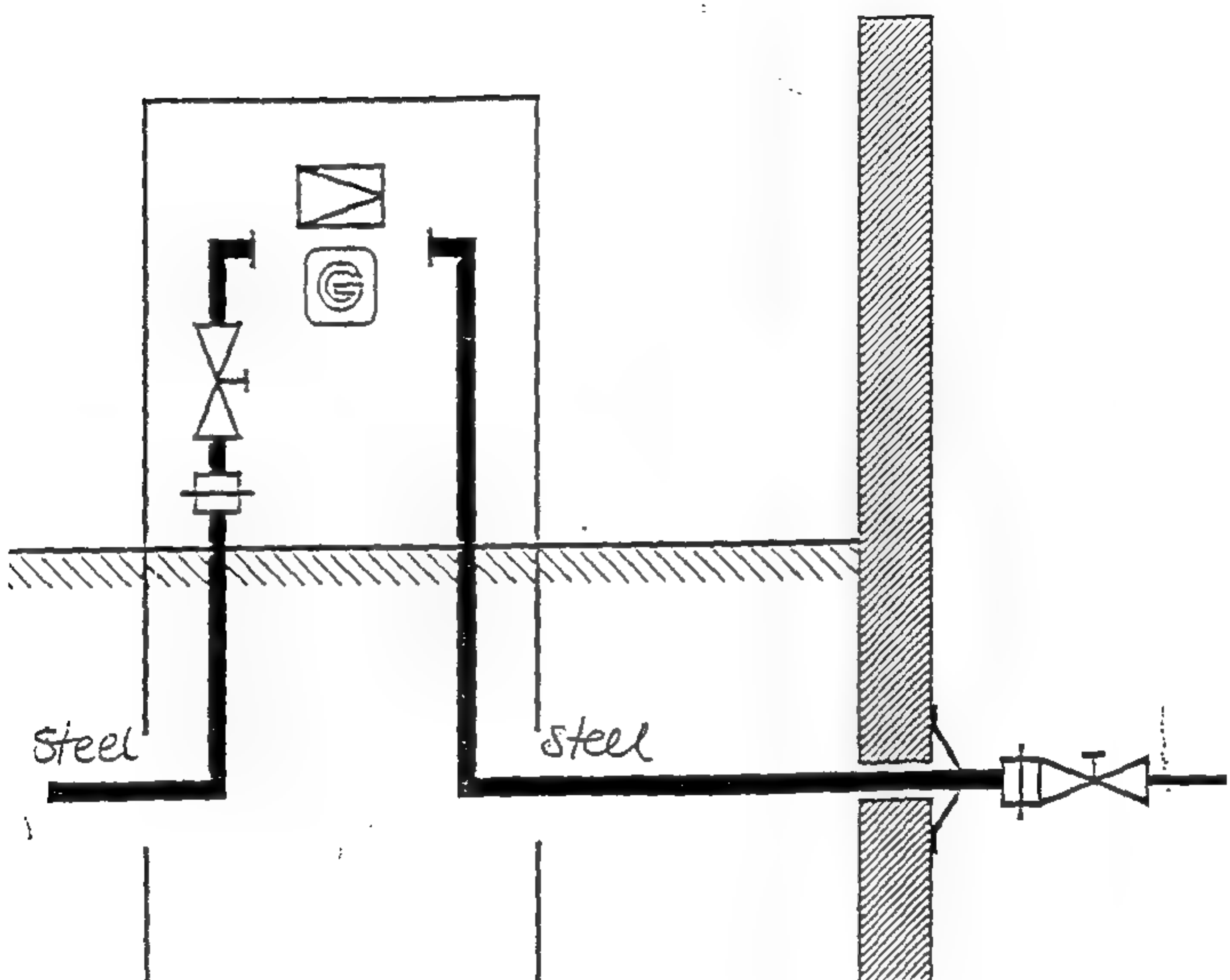
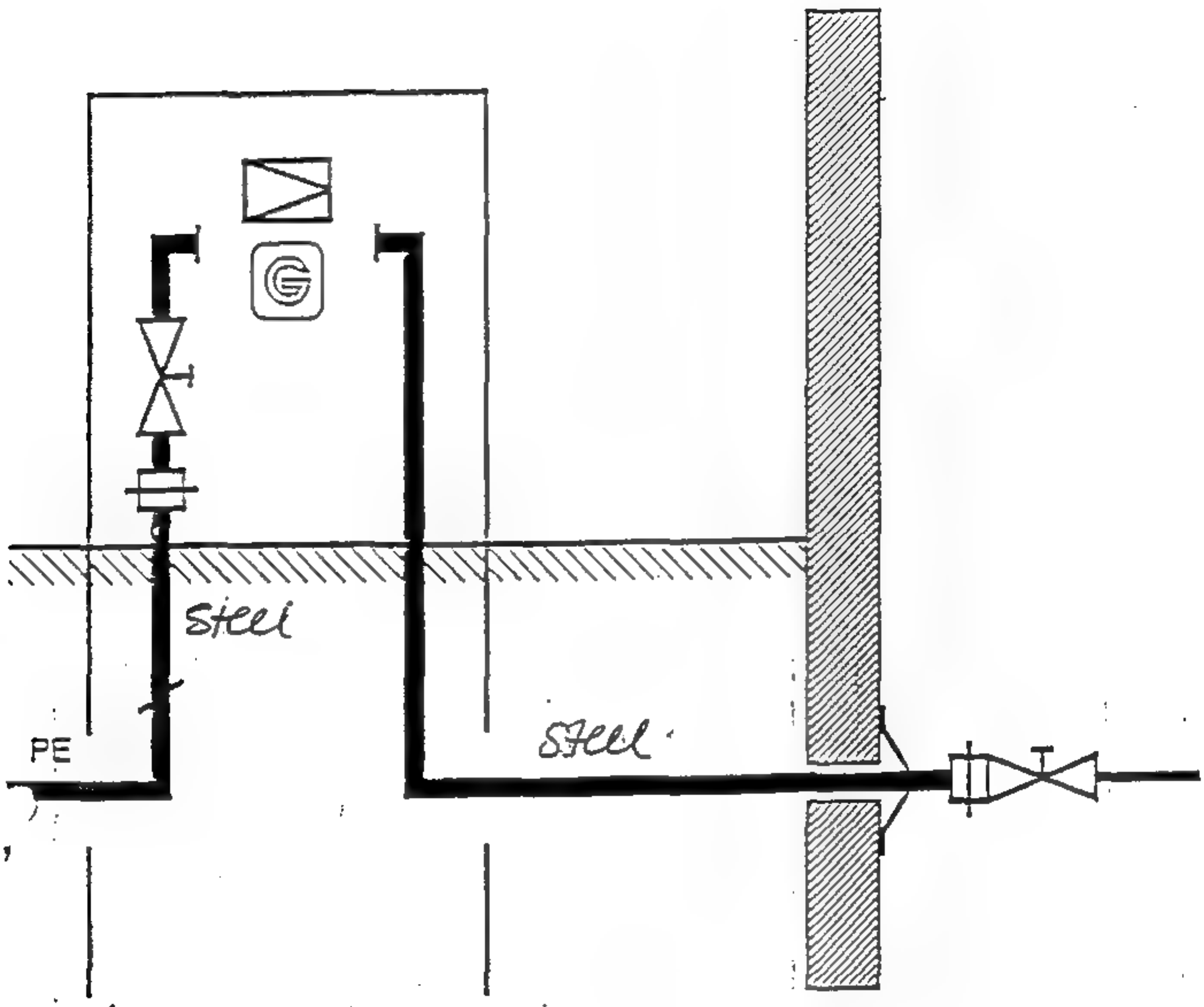


Fig. 26 Insulating joints in detached control box and/or meter case made of plastic (foundations made of plastic)



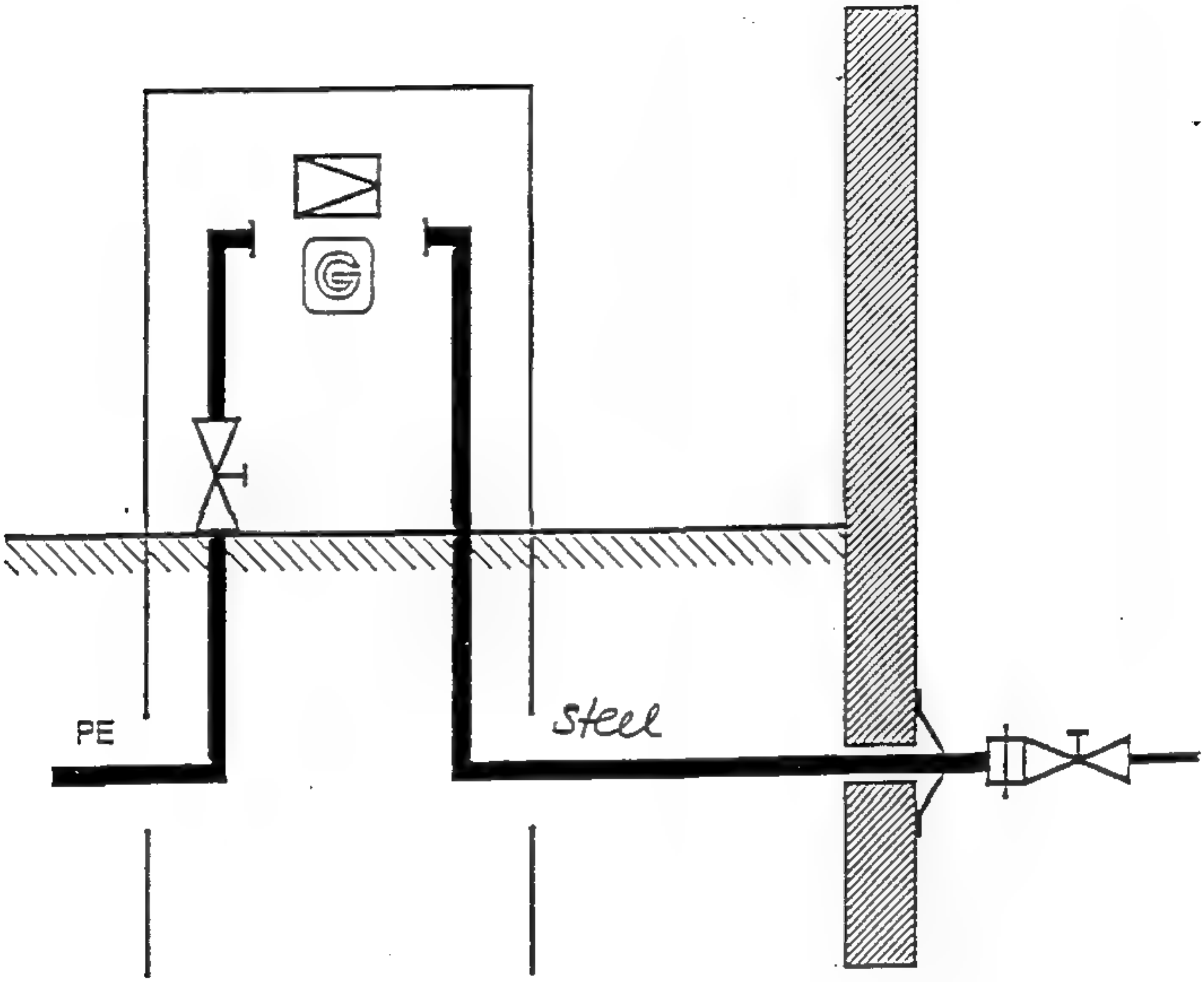
if the machinery part is earthed an electrical interface has to be built into the buried pipeline (see pic 23)

Fig. 27 Insulating joint in detached control box and/or meter case made of plastic (foundations made of plastic); house-connection line made of PE - transition to steel before inlet into the box (case)



if the machinery part is earthed on electrical interface must be built into the buried estate pipeline (see fig 24)

Fig. 28 No insulating joint in detached control box and/or meter case made of plastic (foundations made of plastic); house-connection line made of PE - transition to steel immediately at the inlet into the box (case)



if the machinery part is earthed an electrical interface must be built into the estate pipeline (see fig 25)

Fig. 29 Insulating joint in control box and/or meter case at or in the exterior house wall; house-connection line made of steel or PE with transition to steel before the inlet into the box (case)

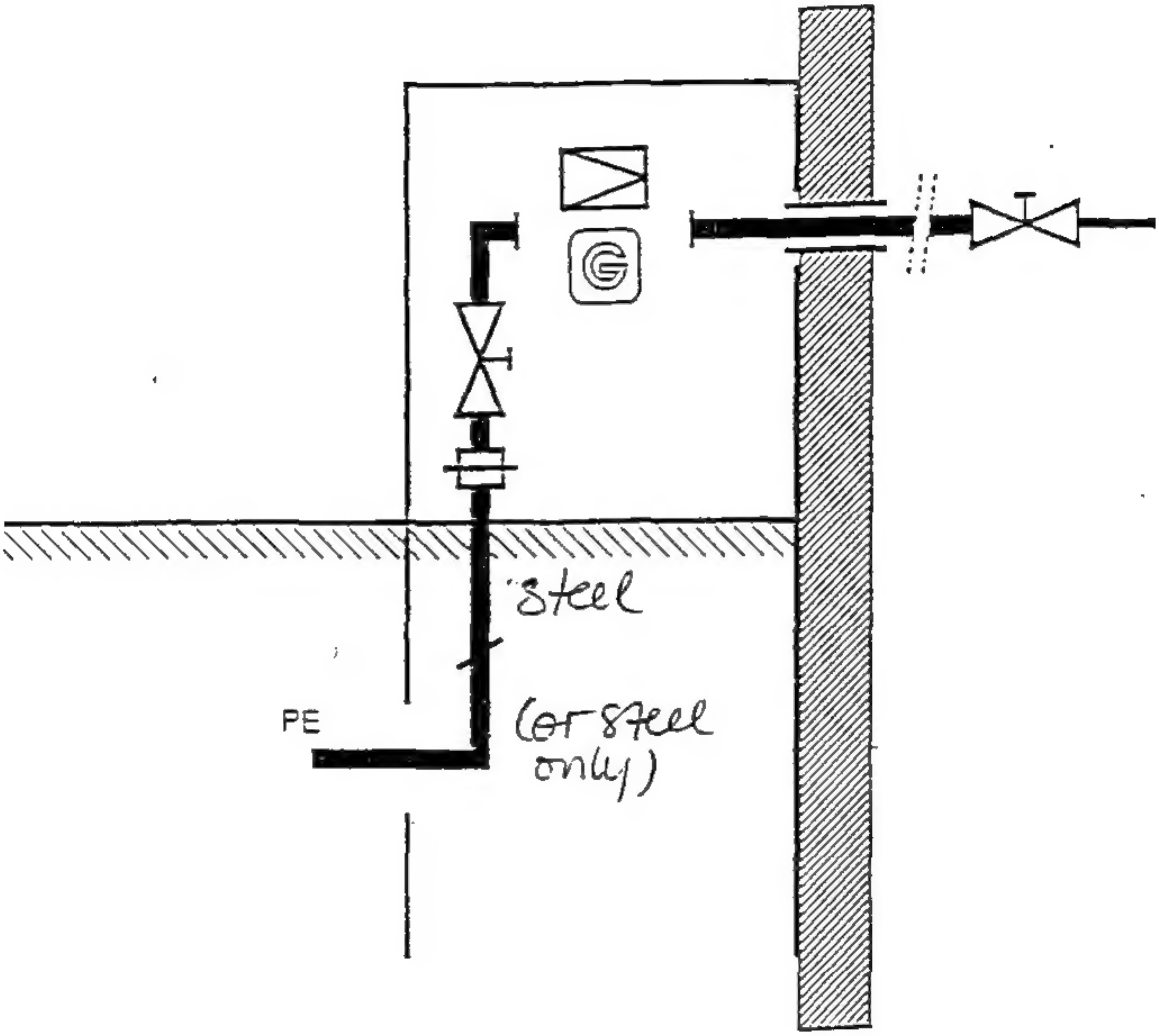


Fig. 30 No insulating joint in control box and/or meter case at or in the exterior house wall; house-connection line made of steel or PE - transition to steel immediately at the inlet into the box (case)

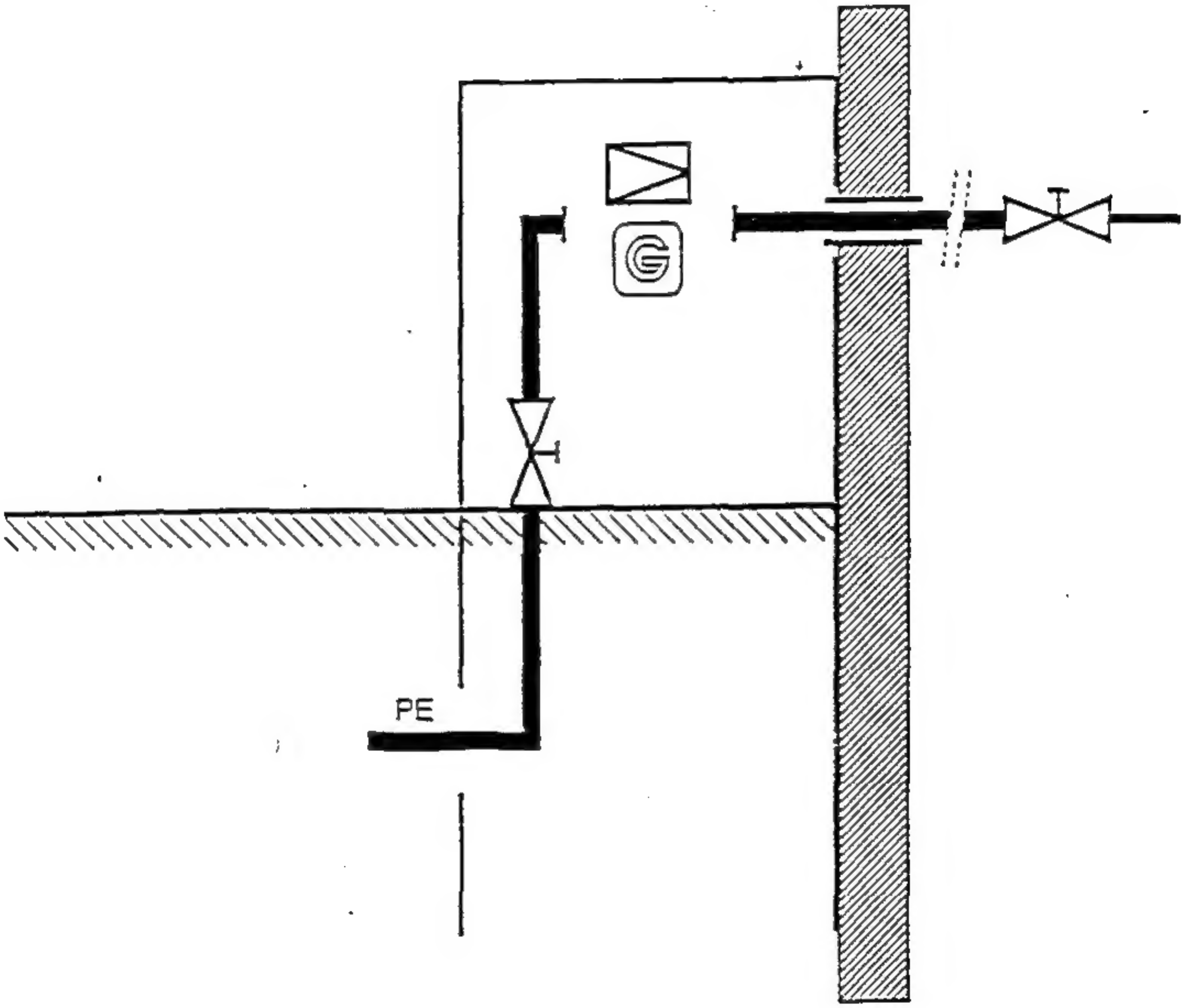


Fig. 31 Insulating joint in control box and/or meter case at or in the exterior house wall; house-connection line made of steel or PE with transition to steel before the inlet into the box (case)- lead-in of the steel line into a building without cellar.

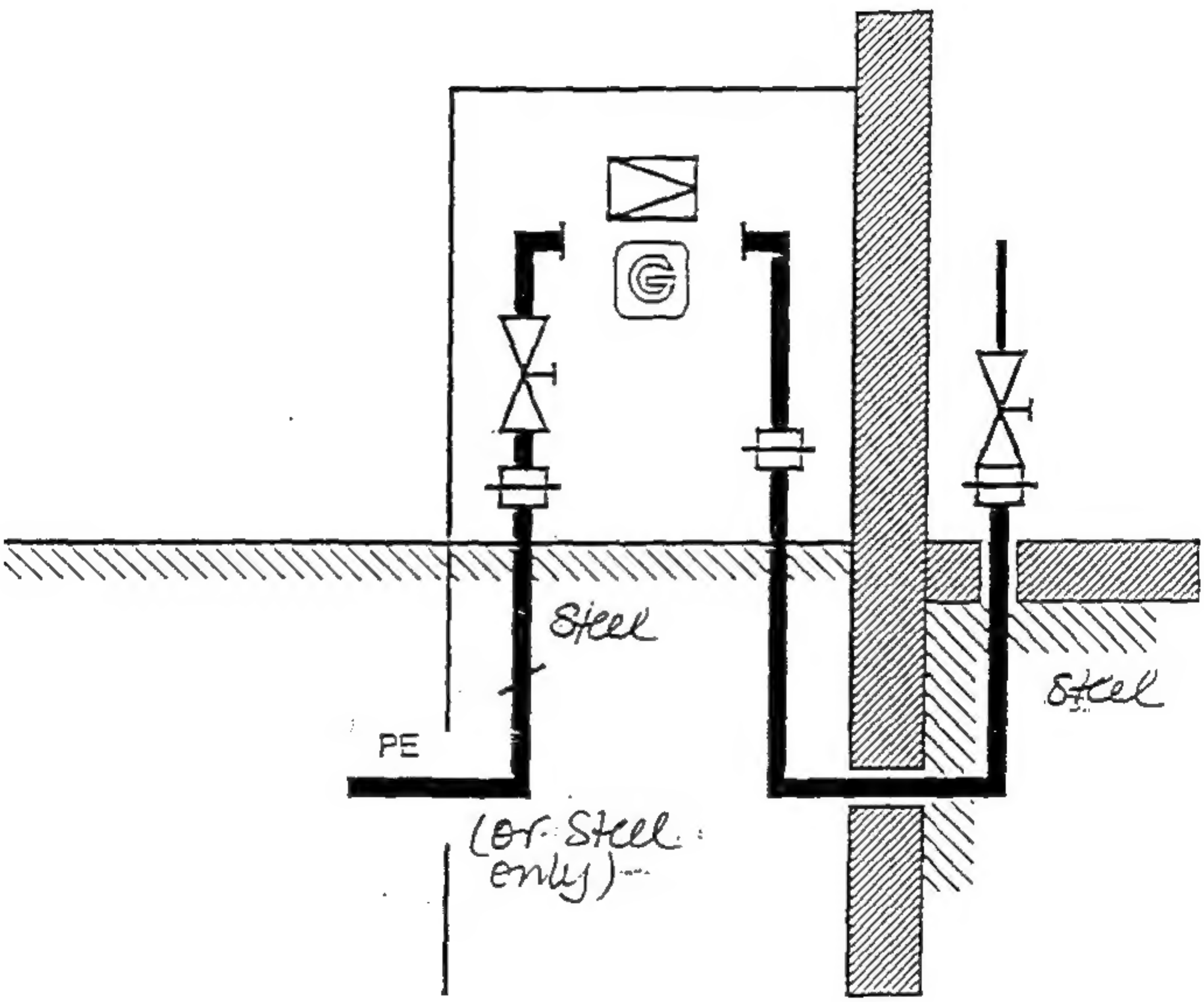


Fig. 32 Steel lines on bridges; interruption of the cathodic protection in bridges through installation of insulating joints (basic scheme)